



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 10:44 AM UTC

PDB ID : 1SF2 / pdb_00001sf2
Title : Structure of E. coli gamma-aminobutyrate aminotransferase
Authors : Liu, W.; Peterson, P.E.; Carter, R.J.; Zhou, X.; Langston, J.A.; Fisher, A.J.;
Toney, M.D.
Deposited on : 2004-02-19
Resolution : 2.40 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) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

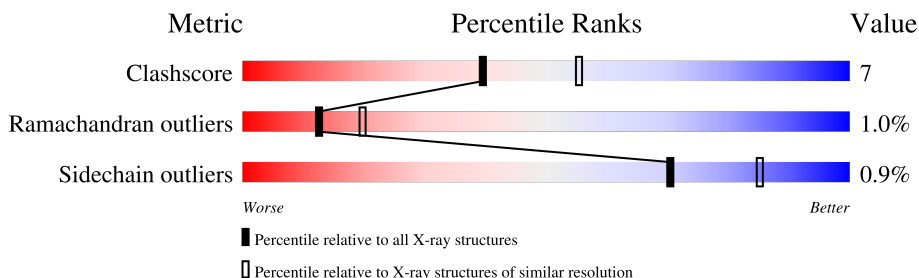
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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))
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	426	 83% 15% .
1	B	426	 82% 16% .
1	C	426	 81% 18% .
1	D	426	 81% 18% .

2 Entry composition [i](#)

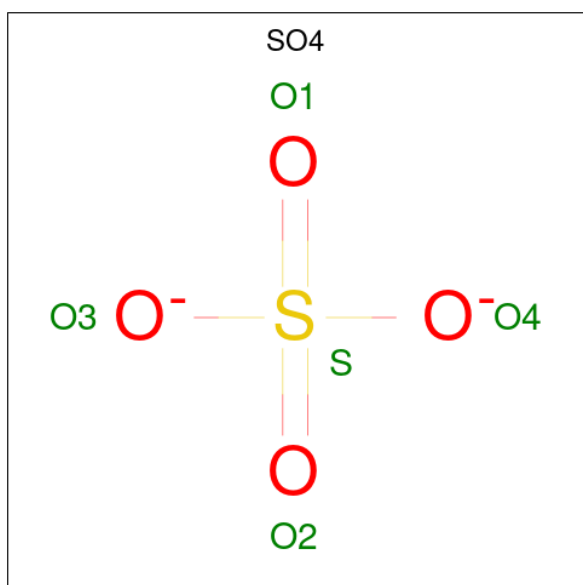
There are 5 unique types of molecules in this entry. The entry contains 14039 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 4-aminobutyrate aminotransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	425	Total	C	N	O	S	0	1	0
			3212	2029	562	603	18			
1	B	425	Total	C	N	O	S	0	0	0
			3206	2026	561	601	18			
1	C	425	Total	C	N	O	S	0	0	0
			3206	2026	561	601	18			
1	D	425	Total	C	N	O	S	0	1	0
			3212	2029	562	603	18			

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



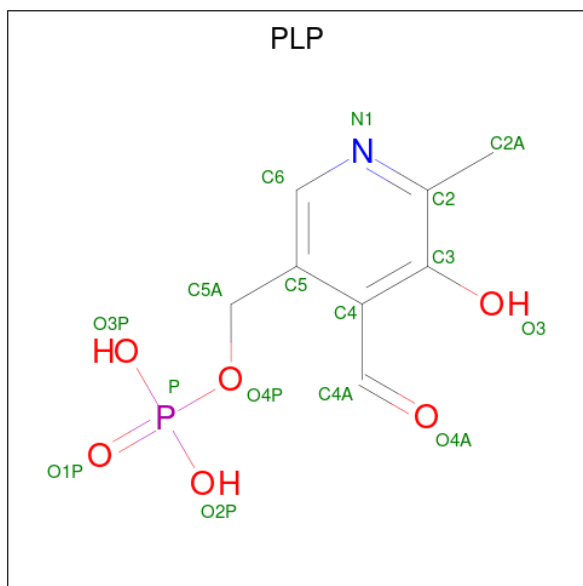
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	A	1	Total	O	S	0	0
			5	4	1		

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

- Molecule 3 is PYRIDOXAL-5'-PHOSPHATE (CCD ID: PLP) (formula: $C_8H_{10}NO_6P$).



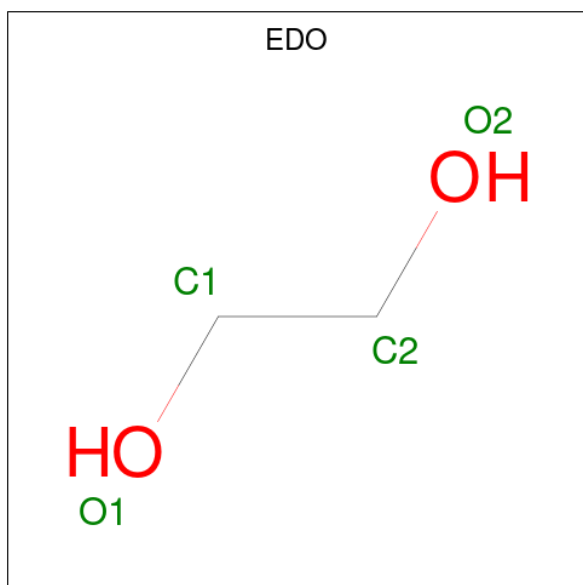
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total 15	C 8	N 1	O 5	P 1	0	0
3	B	1	Total 15	C 8	N 1	O 5	P 1	0	0

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	C	1	Total	C	N	O	P	0	0
			15	8	1	5	1		
3	D	1	Total	C	N	O	P	0	0
			15	8	1	5	1		

- Molecule 4 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		
4	C	1	Total	C	O	0	0
			4	2	2		
4	C	1	Total	C	O	0	0
			4	2	2		
4	C	1	Total	C	O	0	0
			4	2	2		
4	C	1	Total	C	O	0	0
			4	2	2		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	D	1	Total	C	O	0	0
			4	2	2		
4	D	1	Total	C	O	0	0
			4	2	2		
4	D	1	Total	C	O	0	0
			4	2	2		
4	D	1	Total	C	O	0	0
			4	2	2		

- Molecule 5 is water.

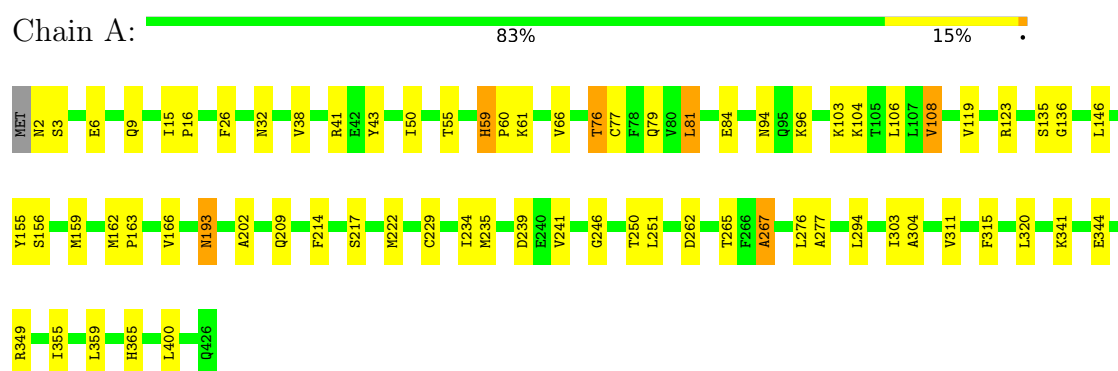
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	266	Total	O	0	0
			266	266		
5	B	274	Total	O	0	0
			274	274		
5	C	231	Total	O	0	0
			231	231		
5	D	265	Total	O	0	0
			265	265		

3 Residue-property plots [i](#)

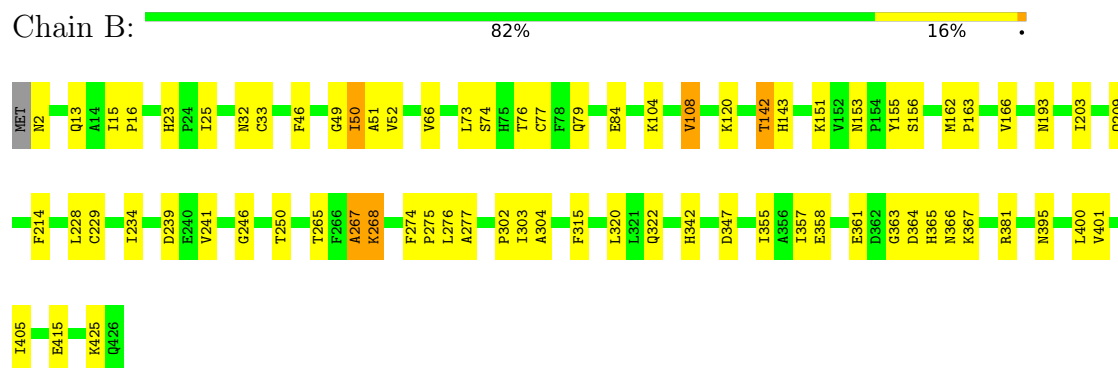
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS was not executed.

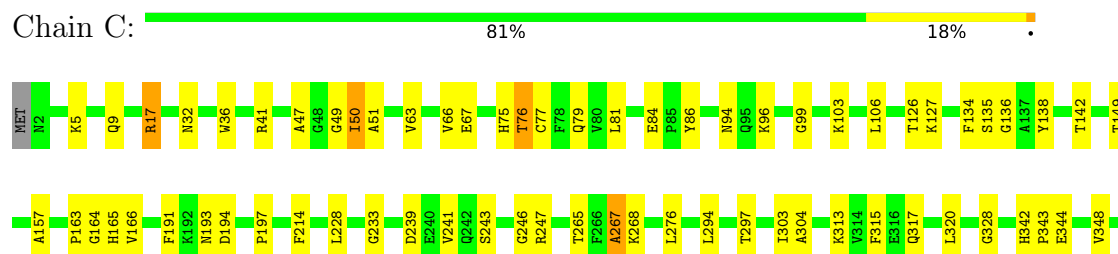
- Molecule 1: 4-aminobutyrate aminotransferase

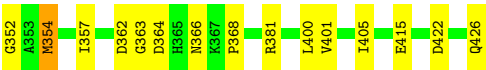


- Molecule 1: 4-aminobutyrate aminotransferase

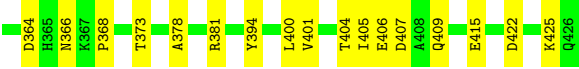
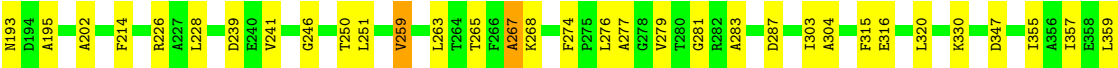
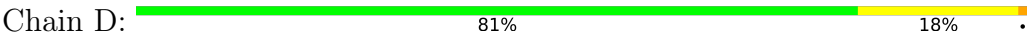


- Molecule 1: 4-aminobutyrate aminotransferase





● Molecule 1: 4-aminobutyrate aminotransferase



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	108.09 Å 108.09 Å 301.25 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.40	Depositor
% Data completeness (in resolution range)	(Not available) (30.00-2.40)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.165 , 0.211	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	14039	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

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: EDO, SO4, 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	0.50	0/3271	0.93	12/4427 (0.3%)
1	B	0.50	0/3265	0.94	8/4419 (0.2%)
1	C	0.47	0/3265	0.94	13/4419 (0.3%)
1	D	0.49	0/3271	0.95	13/4427 (0.3%)
All	All	0.49	0/13072	0.94	46/17692 (0.3%)

There are no bond length outliers.

The worst 5 of 46 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	246	GLY	N-CA-C	6.96	124.25	115.21
1	D	142	THR	N-CA-C	-6.78	100.49	110.52
1	C	142	THR	N-CA-C	-6.73	100.83	110.59
1	D	246	GLY	N-CA-C	6.49	123.97	115.40
1	B	142	THR	N-CA-C	-6.46	100.96	110.52

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	3212	0	3223	46	0
1	B	3206	0	3218	46	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	3206	0	3218	49	0
1	D	3212	0	3222	47	0
2	A	10	0	0	0	0
2	B	15	0	0	0	0
2	C	10	0	0	0	0
2	D	20	0	0	0	0
3	A	15	0	7	0	0
3	B	15	0	7	0	0
3	C	15	0	7	0	0
3	D	15	0	6	0	0
4	A	12	0	18	1	0
4	B	8	0	12	2	0
4	C	16	0	24	2	0
4	D	16	0	24	4	0
5	A	266	0	0	4	0
5	B	274	0	0	7	0
5	C	231	0	0	6	0
5	D	265	0	0	3	0
All	All	14039	0	12986	174	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.

The worst 5 of 174 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:D:2:ASN:HA	5:D:1392:HOH:O	1.75	0.85
1:D:121:ILE:HD12	5:D:1339:HOH:O	1.86	0.76
1:D:279:VAL:HG21	5:D:1339:HOH:O	1.89	0.72
1:B:25:ILE:HD11	1:B:381:ARG:HD3	1.72	0.71
1:C:348:VAL:HG22	1:C:357:ILE:HG22	1.73	0.70

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	424/426 (100%)	402 (95%)	17 (4%)	5 (1%)	10	16
1	B	423/426 (99%)	398 (94%)	19 (4%)	6 (1%)	9	13
1	C	423/426 (99%)	397 (94%)	23 (5%)	3 (1%)	18	28
1	D	424/426 (100%)	399 (94%)	22 (5%)	3 (1%)	18	28
All	All	1694/1704 (99%)	1596 (94%)	81 (5%)	17 (1%)	12	20

5 of 17 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	155	TYR
1	A	365	HIS
1	B	267	ALA
1	A	267	ALA
1	D	267	ALA

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	330/330 (100%)	329 (100%)	1 (0%)	86	93
1	B	329/330 (100%)	327 (99%)	2 (1%)	78	89
1	C	329/330 (100%)	326 (99%)	3 (1%)	70	85
1	D	330/330 (100%)	324 (98%)	6 (2%)	51	73
All	All	1318/1320 (100%)	1306 (99%)	12 (1%)	70	85

5 of 12 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	154	PRO
1	D	259	VAL
1	D	415	GLU

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Mol	Chain	Res	Type
1	D	316	GLU
1	C	17	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 27 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	94	ASN
1	C	193	ASN
1	D	256	GLN
1	C	117	ASN
1	C	242	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](#)

28 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	C	1110	-	4,4,4	1.88	2 (50%)	6,6,6	0.80	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	SO4	D	1111	-	4,4,4	1.82	2 (50%)	6,6,6	0.87	0
4	EDO	C	1203	-	3,3,3	0.42	0	2,2,2	0.47	0
2	SO4	A	1107	-	4,4,4	1.91	2 (50%)	6,6,6	0.80	0
3	PLP	C	450	1	15,15,16	2.49	7 (46%)	21,22,23	2.36	8 (38%)
4	EDO	A	1213	-	3,3,3	0.48	0	2,2,2	0.43	0
4	EDO	D	1207	-	3,3,3	0.47	0	2,2,2	0.43	0
2	SO4	D	1105	-	4,4,4	1.85	2 (50%)	6,6,6	0.92	0
2	SO4	B	1103	-	4,4,4	1.83	2 (50%)	6,6,6	0.87	0
3	PLP	A	450	1	15,15,16	2.32	7 (46%)	21,22,23	2.78	8 (38%)
4	EDO	A	1208	-	3,3,3	0.45	0	2,2,2	0.40	0
4	EDO	C	1209	-	3,3,3	0.37	0	2,2,2	0.47	0
2	SO4	D	1106	-	4,4,4	1.83	2 (50%)	6,6,6	0.88	0
4	EDO	B	1202	-	3,3,3	0.55	0	2,2,2	0.38	0
3	PLP	B	450	1	15,15,16	2.57	6 (40%)	21,22,23	2.44	9 (42%)
4	EDO	D	1212	-	3,3,3	0.51	0	2,2,2	0.40	0
2	SO4	D	1109	-	4,4,4	1.88	2 (50%)	6,6,6	0.83	0
3	PLP	D	450	1	15,15,16	2.39	9 (60%)	21,22,23	2.30	6 (28%)
4	EDO	C	1211	-	3,3,3	0.58	0	2,2,2	0.26	0
2	SO4	B	1108	-	4,4,4	1.86	2 (50%)	6,6,6	0.85	0
4	EDO	C	1206	-	3,3,3	0.58	0	2,2,2	0.35	0
4	EDO	D	1205	-	3,3,3	0.43	0	2,2,2	0.43	0
2	SO4	A	1101	-	4,4,4	1.90	2 (50%)	6,6,6	0.81	0
2	SO4	B	1102	-	4,4,4	1.87	2 (50%)	6,6,6	0.82	0
4	EDO	B	1201	-	3,3,3	0.48	0	2,2,2	0.39	0
4	EDO	A	1210	-	3,3,3	0.51	0	2,2,2	0.33	0
4	EDO	D	1204	-	3,3,3	0.49	0	2,2,2	0.40	0
2	SO4	C	1104	-	4,4,4	1.89	2 (50%)	6,6,6	0.82	0

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
4	EDO	D	1207	-	-	0/1/1/1	-
4	EDO	C	1211	-	-	0/1/1/1	-
4	EDO	B	1202	-	-	0/1/1/1	-
4	EDO	D	1205	-	-	0/1/1/1	-
3	PLP	B	450	1	-	0/6/6/8	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	PLP	A	450	1	-	0/6/6/8	0/1/1/1
4	EDO	B	1201	-	-	0/1/1/1	-
4	EDO	A	1210	-	-	0/1/1/1	-
4	EDO	C	1203	-	-	0/1/1/1	-
4	EDO	D	1204	-	-	0/1/1/1	-
4	EDO	D	1212	-	-	1/1/1/1	-
4	EDO	C	1209	-	-	0/1/1/1	-
3	PLP	C	450	1	-	0/6/6/8	0/1/1/1
4	EDO	A	1208	-	-	0/1/1/1	-
4	EDO	C	1206	-	-	1/1/1/1	-
4	EDO	A	1213	-	-	0/1/1/1	-
3	PLP	D	450	1	-	0/6/6/8	0/1/1/1

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	450	PLP	C3-C2	6.07	1.47	1.41
3	C	450	PLP	C3-C2	5.50	1.46	1.41
3	B	450	PLP	C2-N1	4.37	1.41	1.33
3	A	450	PLP	C2-N1	4.11	1.41	1.33
3	C	450	PLP	P-O1P	4.03	1.63	1.50

The worst 5 of 31 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	450	PLP	C5A-C5-C6	-6.20	109.25	119.36
3	A	450	PLP	C5A-C5-C6	-6.17	109.30	119.36
3	D	450	PLP	C5A-C5-C6	-6.11	109.40	119.36
3	A	450	PLP	C4A-C4-C3	-5.90	110.69	120.52
3	C	450	PLP	C5A-C5-C6	-5.82	109.87	119.36

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	D	1212	EDO	O1-C1-C2-O2
4	C	1206	EDO	O1-C1-C2-O2

There are no ring outliers.

7 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	1213	EDO	1	0
4	D	1207	EDO	1	0
4	C	1209	EDO	2	0
4	B	1202	EDO	1	0
4	D	1212	EDO	2	0
4	D	1205	EDO	1	0
4	B	1201	EDO	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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.