



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 09:25 AM UTC

PDB ID : 1SAY / pdb_00001say
Title : L-ALANINE DEHYDROGENASE COMPLEXED WITH PYRUVATE
Authors : Baker, P.J.; Sawa, Y.; Shibata, H.; Sedelnikova, S.E.; Rice, D.W.
Deposited on : 1998-06-05
Resolution : 2.10 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)	:	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

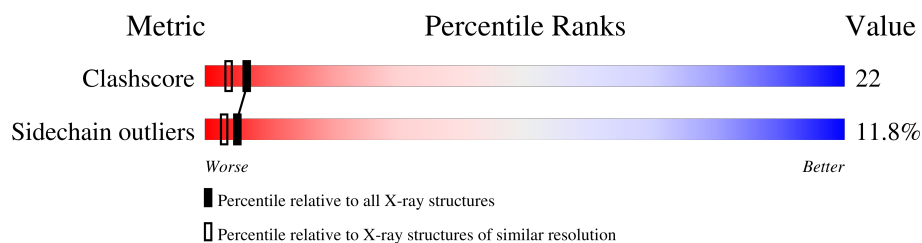
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.10 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	7164 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)

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	361	

2 Entry composition [i](#)

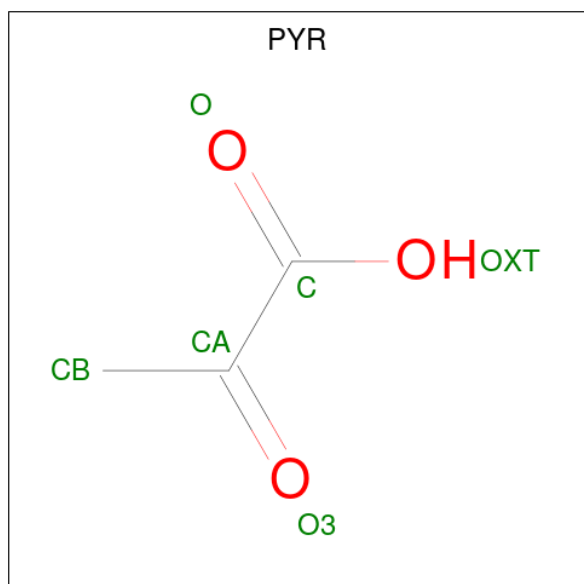
There are 3 unique types of molecules in this entry. The entry contains 2817 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 L-ALANINE DEHYDROGENASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	361	Total	C	N	O	S	0	0	0
			2715	1730	467	509	9			

- Molecule 2 is PYRUVIC ACID (CCD ID: PYR) (formula: $C_3H_4O_3$).



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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	96	Total	O	0	0
			96	96		

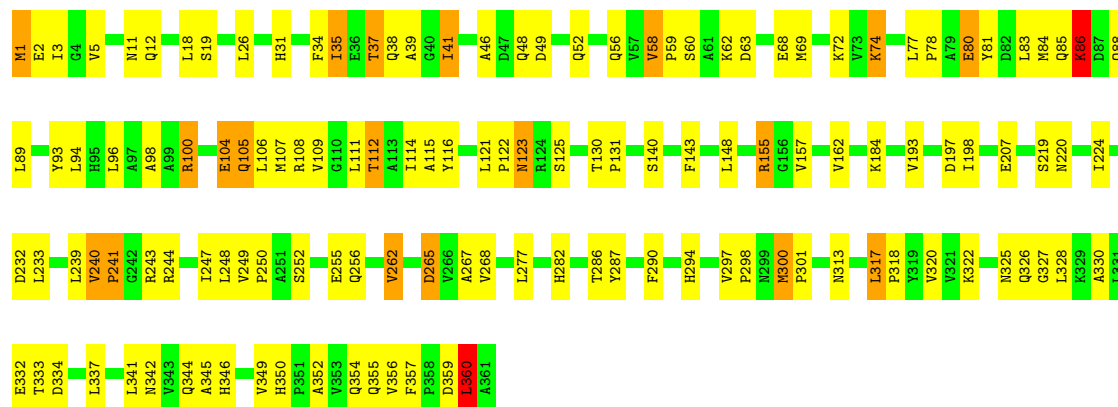
3 Residue-property plots

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. 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: L-ALANINE DEHYDROGENASE

Chain A: 



4 Data and refinement statistics

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

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, α , β , γ	122.40Å 122.40Å 183.00Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.10	Depositor
% Data completeness (in resolution range)	78.0 (30.00-2.10)	Depositor
R_{merge}	0.03	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	TNT 5E	Depositor
R, R_{free}	0.180 , 0.250	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2817	wwPDB-VP
Average B, all atoms (Å ²)	39.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: PYR

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	1.14	4/2765 (0.1%)	1.02	13/3766 (0.3%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	300	MET	SD-CE	-6.72	1.62	1.79
1	A	265	ASP	CA-C	-5.81	1.45	1.52
1	A	162	VAL	CA-CB	5.74	1.61	1.54
1	A	262	VAL	CA-CB	5.24	1.61	1.54

All (13) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	41	ILE	N-CA-C	7.14	118.76	110.62
1	A	248	LEU	N-CA-C	-6.94	104.96	113.50
1	A	86	LYS	N-CA-C	6.90	119.39	111.11
1	A	240	VAL	CA-C-N	6.49	127.95	119.84
1	A	240	VAL	C-N-CA	6.49	127.95	119.84
1	A	241	PRO	N-CA-C	6.40	125.65	112.47
1	A	232	ASP	N-CA-C	-6.36	105.17	113.12
1	A	193	VAL	N-CA-C	5.90	116.98	108.48
1	A	262	VAL	N-CA-C	5.59	116.53	108.48
1	A	88	GLN	N-CA-C	5.26	117.51	110.35
1	A	354	GLN	N-CA-C	-5.26	105.44	111.07
1	A	360	LEU	N-CA-C	-5.24	107.05	113.50
1	A	244	ARG	N-CA-C	5.18	121.83	110.80

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	2715	0	2775	120	1
2	A	6	0	0	0	0
3	A	96	0	0	5	0
All	All	2817	0	2775	120	1

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 22.

All (120) 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:155:ARG:NH1	3:A:585:HOH:O	1.74	1.17
1:A:58:VAL:HG11	1:A:63:ASP:HB2	1.32	1.11
1:A:58:VAL:CG1	1:A:63:ASP:HB2	1.84	1.07
1:A:84:MET:HE1	1:A:106:LEU:CD2	2.01	0.91
1:A:155:ARG:CD	3:A:558:HOH:O	2.19	0.90
1:A:81:TYR:CE2	1:A:105:GLN:HG3	2.10	0.87
1:A:84:MET:HE1	1:A:106:LEU:HD23	1.56	0.86
1:A:1:MET:N	1:A:31:HIS:HD2	1.75	0.84
1:A:58:VAL:HG13	1:A:59:PRO:HD2	1.59	0.82
1:A:81:TYR:CD2	1:A:105:GLN:HG3	2.14	0.82
1:A:58:VAL:HG11	1:A:63:ASP:CB	2.07	0.81
1:A:18:LEU:HA	1:A:313:ASN:HD21	1.45	0.81
1:A:84:MET:HE2	1:A:111:LEU:HD21	1.62	0.79
1:A:155:ARG:HD3	3:A:558:HOH:O	1.82	0.78
1:A:1:MET:H1	1:A:31:HIS:HD2	1.30	0.78
1:A:100:ARG:HD3	1:A:104:GLU:OE1	1.85	0.77
1:A:58:VAL:CG1	1:A:63:ASP:CB	2.64	0.75
1:A:155:ARG:HD2	3:A:558:HOH:O	1.81	0.75
1:A:34:PHE:CE2	1:A:56:GLN:OE1	2.40	0.74
1:A:89:LEU:CD2	1:A:112:THR:OG1	2.37	0.73
1:A:1:MET:HG3	1:A:2:GLU:N	2.02	0.72
1:A:265:ASP:O	1:A:268:VAL:HG13	1.89	0.72
1:A:58:VAL:HG13	1:A:63:ASP:HB2	1.73	0.68
1:A:31:HIS:CE1	1:A:325:ASN:OD1	2.47	0.68

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:121:LEU:HD12	1:A:125:SER:OG	1.96	0.66
1:A:31:HIS:HE1	1:A:325:ASN:OD1	1.79	0.65
1:A:89:LEU:HD23	1:A:112:THR:OG1	1.97	0.65
1:A:143:PHE:CD2	1:A:300:MET:HE2	2.32	0.64
1:A:100:ARG:NH2	1:A:359:ASP:OD2	2.30	0.63
1:A:58:VAL:HG13	1:A:59:PRO:CD	2.29	0.63
1:A:352:ALA:O	1:A:356:VAL:HG23	1.98	0.63
1:A:239:LEU:HD12	1:A:267:ALA:HB2	1.81	0.63
1:A:220:ASN:O	1:A:224:ILE:HG13	2.00	0.61
1:A:265:ASP:HB3	1:A:277:LEU:HD23	1.83	0.61
1:A:11:ASN:O	1:A:12:GLN:HB2	2.00	0.61
1:A:143:PHE:HD2	1:A:300:MET:CE	2.13	0.61
1:A:345:ALA:O	1:A:346:HIS:HB2	1.99	0.61
1:A:313:ASN:O	1:A:317:LEU:HB2	2.01	0.60
1:A:2:GLU:HG2	1:A:34:PHE:CE1	2.37	0.59
1:A:334:ASP:HB3	1:A:337:LEU:HB2	1.84	0.59
1:A:112:THR:HB	1:A:344:GLN:HG3	1.84	0.59
1:A:357:PHE:HB3	1:A:360:LEU:HB2	1.85	0.59
1:A:255:GLU:HA	1:A:290:PHE:CD2	2.39	0.58
1:A:123:ASN:N	1:A:123:ASN:OD1	2.37	0.58
1:A:1:MET:N	1:A:31:HIS:CD2	2.65	0.57
1:A:69:MET:HE1	1:A:320:VAL:HG13	1.87	0.57
1:A:62:LYS:HA	1:A:83:LEU:HD22	1.85	0.56
1:A:69:MET:CE	1:A:320:VAL:HG13	2.36	0.56
1:A:143:PHE:CD2	1:A:300:MET:CE	2.88	0.56
1:A:2:GLU:HG2	1:A:34:PHE:HE1	1.70	0.56
1:A:86:LYS:HG3	1:A:109:VAL:O	2.05	0.55
1:A:35:ILE:HD11	1:A:39:ALA:HB3	1.89	0.55
1:A:240:VAL:HG12	1:A:243:ARG:O	2.06	0.55
1:A:107:MET:O	1:A:346:HIS:CD2	2.60	0.55
1:A:342:ASN:HA	1:A:350:HIS:HB2	1.88	0.54
1:A:81:TYR:CE2	1:A:105:GLN:CG	2.89	0.54
1:A:107:MET:O	1:A:346:HIS:HD2	1.91	0.54
1:A:37:THR:O	1:A:38:GLN:HB2	2.08	0.54
1:A:1:MET:H1	1:A:31:HIS:CD2	2.20	0.53
1:A:240:VAL:HG12	1:A:240:VAL:O	2.08	0.53
1:A:80:GLU:HA	1:A:83:LEU:HD12	1.91	0.52
1:A:105:GLN:OE1	1:A:108:ARG:NH2	2.42	0.52
1:A:3:ILE:HG12	1:A:69:MET:HE2	1.90	0.52
1:A:5:VAL:CG1	1:A:35:ILE:HD12	2.39	0.52
1:A:155:ARG:HG3	1:A:157:VAL:HG23	1.91	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:78:PRO:HA	1:A:81:TYR:CD1	2.45	0.51
1:A:81:TYR:CD2	1:A:105:GLN:CG	2.92	0.51
1:A:239:LEU:HD11	1:A:267:ALA:HA	1.94	0.50
1:A:143:PHE:CE2	1:A:300:MET:HE2	2.47	0.50
1:A:286:THR:HA	1:A:294:HIS:O	2.12	0.50
1:A:5:VAL:HB	1:A:35:ILE:HD12	1.92	0.49
1:A:58:VAL:HG13	1:A:63:ASP:CB	2.38	0.49
1:A:19:SER:H	1:A:313:ASN:ND2	2.10	0.49
1:A:197:ASP:C	1:A:219:SER:OG	2.55	0.48
1:A:1:MET:H3	1:A:31:HIS:HD2	1.60	0.48
1:A:252:SER:O	1:A:256:GLN:HG3	2.13	0.48
1:A:93:TYR:CD1	1:A:116:TYR:HB2	2.49	0.48
1:A:282:HIS:HE1	3:A:565:HOH:O	1.95	0.48
1:A:89:LEU:HD23	1:A:89:LEU:HA	1.48	0.48
1:A:34:PHE:CD1	1:A:34:PHE:N	2.82	0.48
1:A:265:ASP:CB	1:A:277:LEU:HD23	2.44	0.48
1:A:330:ALA:HA	1:A:333:THR:OG1	2.14	0.47
1:A:130:THR:OG1	1:A:131:PRO:HD3	2.14	0.47
1:A:277:LEU:CD1	1:A:294:HIS:HB3	2.44	0.47
1:A:96:LEU:C	1:A:98:ALA:H	2.23	0.47
1:A:121:LEU:HB3	1:A:122:PRO:HD2	1.97	0.47
1:A:1:MET:H3	1:A:31:HIS:CD2	2.32	0.46
1:A:255:GLU:HB2	1:A:290:PHE:CE2	2.51	0.46
1:A:77:LEU:HB3	1:A:78:PRO:HD2	1.97	0.46
1:A:341:LEU:HD21	1:A:344:GLN:HE21	1.81	0.45
1:A:300:MET:N	1:A:301:PRO:CD	2.79	0.45
1:A:255:GLU:CA	1:A:290:PHE:CD2	3.00	0.45
1:A:297:VAL:HA	1:A:298:PRO:HD3	1.79	0.45
1:A:317:LEU:HB3	1:A:318:PRO:CD	2.47	0.45
1:A:345:ALA:O	1:A:346:HIS:CB	2.63	0.45
1:A:357:PHE:CB	1:A:360:LEU:HB2	2.47	0.44
1:A:48:GLN:O	1:A:52:GLN:HG3	2.17	0.44
1:A:277:LEU:HD12	1:A:294:HIS:HB3	1.99	0.44
1:A:337:LEU:HD23	1:A:337:LEU:HA	1.80	0.44
1:A:108:ARG:O	1:A:346:HIS:CD2	2.71	0.44
1:A:247:ILE:N	1:A:247:ILE:HD13	2.33	0.43
1:A:60:SER:OG	1:A:63:ASP:OD2	2.18	0.43
1:A:94:LEU:HD12	1:A:115:ALA:HB2	2.01	0.43
1:A:247:ILE:N	1:A:247:ILE:CD1	2.81	0.43
1:A:360:LEU:HA	1:A:360:LEU:HD12	1.46	0.43
1:A:89:LEU:HD21	1:A:112:THR:OG1	2.16	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:249:VAL:HA	1:A:250:PRO:HD2	1.91	0.43
1:A:198:ILE:HG23	1:A:219:SER:OG	2.18	0.42
1:A:240:VAL:HA	1:A:241:PRO:HD3	1.69	0.42
1:A:130:THR:N	1:A:131:PRO:CD	2.82	0.42
1:A:148:LEU:HG	1:A:262:VAL:HG13	2.02	0.42
1:A:317:LEU:HB3	1:A:318:PRO:HD3	2.02	0.42
1:A:317:LEU:HD22	1:A:317:LEU:O	2.20	0.42
1:A:277:LEU:HA	1:A:287:TYR:OH	2.20	0.41
1:A:326:GLN:O	1:A:327:GLY:C	2.63	0.41
1:A:140:SER:HA	1:A:300:MET:HE1	2.02	0.41
1:A:46:ALA:O	1:A:49:ASP:HB2	2.20	0.41
1:A:74:LYS:HA	1:A:74:LYS:HD2	1.48	0.41
1:A:233:LEU:HD23	1:A:262:VAL:HG22	2.03	0.41
1:A:1:MET:HB2	1:A:1:MET:HE2	1.75	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:184:LYS:NZ	1:A:207:GLU:OE2[2_555]	2.14	0.06

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

There are no protein backbone outliers to report in this entry.

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	221/289 (76%)	195 (88%)	26 (12%)	5 3

All (26) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	26	LEU
1	A	35	ILE
1	A	37	THR
1	A	41	ILE
1	A	58	VAL
1	A	68	GLU
1	A	72	LYS
1	A	74	LYS
1	A	80	GLU
1	A	85	GLN
1	A	86	LYS
1	A	100	ARG
1	A	104	GLU
1	A	105	GLN
1	A	112	THR
1	A	114	ILE
1	A	123	ASN
1	A	155	ARG
1	A	317	LEU
1	A	322	LYS
1	A	328	LEU
1	A	332	GLU
1	A	349	VAL
1	A	355	GLN
1	A	360	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	31	HIS
1	A	56	GLN
1	A	85	GLN
1	A	142	GLN
1	A	282	HIS
1	A	299	ASN
1	A	313	ASN
1	A	344	GLN
1	A	346	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 ⓘ

1 ligand is 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	PYR	A	501	-	5,5,5	6.81	2 (40%)	3,6,6	1.84	1 (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
2	PYR	A	501	-	-	0/4/4/4	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	501	PYR	O-C	10.90	1.49	1.22
2	A	501	PYR	OXT-C	10.53	1.59	1.30

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	A	501	PYR	OXT-C-O	-2.65	117.58	123.90

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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

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.