



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 11:49 PM GMT

PDB ID : 5EAA  
Title : ASPARTATE AMINOTRANSFERASE FROM E. COLI, C191S MUTATION  
Authors : Jeffery, C.J.; Gloss, L.M.; Petsko, G.A.; Ringe, D.  
Deposited on : 1998-12-29  
Resolution : 2.40 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](mailto:validation@mail.wwpdb.org)  
A user guide is available at  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

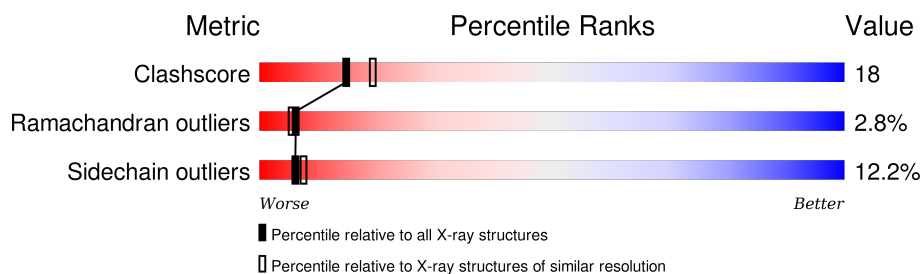
# 1 Overall quality at a glance

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	102246	3407 (2.40-2.40)
Ramachandran outliers	100387	3351 (2.40-2.40)
Sidechain outliers	100360	3352 (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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	396	 63% 30% 7% •

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 3224 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 ASPARTATE AMINOTRANSFERASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	396	3069	1936	536	585	12	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	191	SER	CYS	ENGINEERED	UNP P00509

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (three-letter code: PLP) (formula:  $C_8H_{10}NO_6P$ ).



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

- Molecule 3 is water.

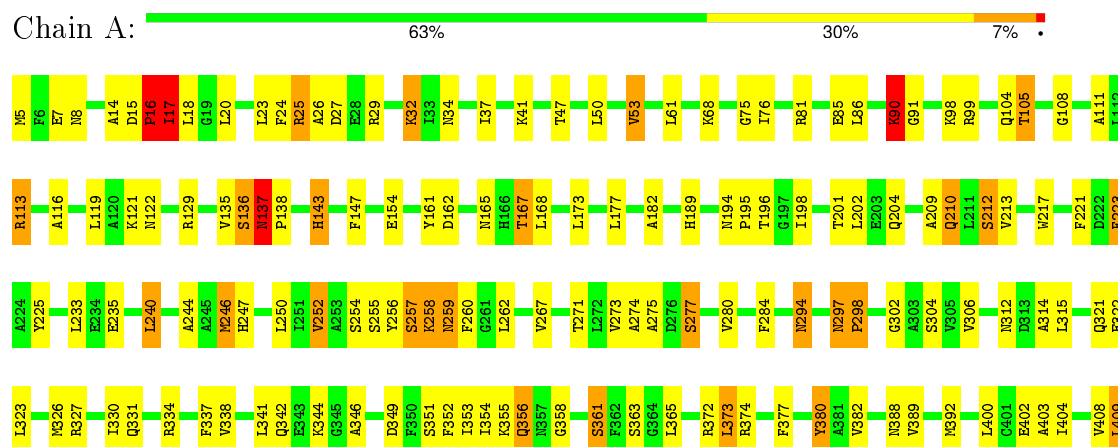
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	140	Total 140	O 140	0	0

### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

Note EDS was not executed.

#### • Molecule 1: ASPARTATE AMINOTRANSFERASE



## 4 Data and refinement statistics

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

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	156.27Å 86.94Å 79.77Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	10.00 – 2.40	Depositor
% Data completeness (in resolution range)	92.0 (10.00-2.40)	Depositor
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	X-PLOR 3.851	Depositor
R, $R_{free}$	0.219 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3224	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	22.0	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: 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	0.79	1/3130 (0.0%)	0.90	6/4240 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	258	LYS	C-N	18.47	1.76	1.34

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	257	SER	O-C-N	-9.74	107.12	122.70
1	A	356	GLN	N-CA-C	-8.72	87.46	111.00
1	A	17	ILE	N-CA-C	-7.58	90.52	111.00
1	A	257	SER	C-N-CA	6.31	137.47	121.70
1	A	257	SER	CA-C-N	5.46	129.22	117.20
1	A	137	ASN	C-N-CD	5.19	139.31	128.40

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	225	TYR	Sidechain
1	A	257	SER	Mainchain

## 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	3069	0	3015	108	0
2	A	15	0	6	0	0
3	A	140	0	0	6	0
All	All	3224	0	3021	108	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 18.

All (108) 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:258:LYS:C	1:A:259:ASN:N	1.76	1.39
1:A:129:ARG:HD3	1:A:154:GLU:HB3	1.51	0.91
1:A:25:ARG:HA	1:A:25:ARG:NE	1.89	0.87
1:A:408:VAL:O	1:A:409:LEU:HB2	1.79	0.82
1:A:37:ILE:HG13	1:A:388:ASN:HD22	1.47	0.79
1:A:50:LEU:HB2	1:A:53:VAL:HG13	1.65	0.77
1:A:27:ASP:HB3	1:A:32:LYS:HZ3	1.50	0.77
1:A:90:LYS:HD3	1:A:90:LYS:H	1.50	0.75
1:A:338:VAL:HG21	1:A:354:ILE:HG13	1.69	0.73
1:A:17:ILE:HG23	1:A:18:LEU:H	1.56	0.70
1:A:252:VAL:HG13	1:A:271:THR:HB	1.77	0.67
1:A:244:ALA:HA	1:A:250:LEU:HD21	1.78	0.66
1:A:76:ILE:HG13	1:A:104:GLN:HE22	1.59	0.66
1:A:24:PHE:CE1	1:A:32:LYS:HG2	2.31	0.64
1:A:201:THR:H	1:A:204:GLN:HE21	1.47	0.63
1:A:344:LYS:HD3	1:A:402:GLU:HG3	1.81	0.62
1:A:99:ARG:HD2	1:A:274:ALA:O	1.99	0.62
1:A:321:GLN:HG3	3:A:578:HOH:O	1.97	0.62
1:A:330:ILE:O	1:A:334:ARG:HG3	2.00	0.61

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:137:ASN:HB3	1:A:138:PRO:CD	2.31	0.60
1:A:177:LEU:O	1:A:217:TRP:HZ2	1.82	0.60
1:A:404:ILE:O	1:A:408:VAL:HG22	2.01	0.60
1:A:15:ASP:O	1:A:17:ILE:HG22	2.02	0.60
1:A:99:ARG:HD3	1:A:275:ALA:O	2.02	0.59
1:A:37:ILE:HG13	1:A:388:ASN:ND2	2.17	0.59
1:A:8:ASN:H	1:A:8:ASN:HD22	1.51	0.58
1:A:338:VAL:CG2	1:A:353:ILE:HB	2.34	0.58
1:A:105:THR:HG21	1:A:111:ALA:N	2.17	0.58
1:A:14:ALA:C	1:A:16:PRO:HD2	2.25	0.56
1:A:201:THR:H	1:A:204:GLN:NE2	2.03	0.56
1:A:27:ASP:HB3	1:A:32:LYS:NZ	2.18	0.56
1:A:15:ASP:HB3	1:A:18:LEU:HB2	1.87	0.56
1:A:25:ARG:HE	1:A:25:ARG:HA	1.70	0.55
1:A:392:MET:HE2	1:A:400:LEU:HD21	1.90	0.54
1:A:17:ILE:HG23	1:A:18:LEU:N	2.24	0.52
1:A:209:ALA:O	1:A:213:VAL:HG23	2.10	0.52
1:A:162:ASP:OD2	1:A:165:ASN:HB2	2.10	0.52
1:A:382:VAL:HG11	3:A:583:HOH:O	2.10	0.52
1:A:338:VAL:HG11	1:A:351:SER:HA	1.92	0.51
1:A:143:HIS:O	1:A:147:PHE:CD2	2.63	0.51
1:A:212:SER:HB3	1:A:247:HIS:CE1	2.45	0.51
1:A:47:THR:HG22	3:A:540:HOH:O	2.10	0.51
1:A:34:ASN:OD1	1:A:37:ILE:HG23	2.10	0.51
1:A:8:ASN:H	1:A:8:ASN:ND2	2.07	0.51
1:A:380:TYR:N	1:A:380:TYR:CD1	2.78	0.51
1:A:334:ARG:HH22	1:A:361:SER:HB3	1.75	0.51
1:A:338:VAL:HG22	1:A:353:ILE:HB	1.94	0.50
1:A:196:THR:HB	1:A:198:ILE:HG13	1.94	0.49
1:A:99:ARG:HD3	1:A:275:ALA:C	2.33	0.48
1:A:129:ARG:CD	1:A:154:GLU:HB3	2.35	0.48
1:A:177:LEU:O	1:A:217:TRP:CZ2	2.65	0.48
1:A:297:ASN:HB2	1:A:298:PRO:HD2	1.95	0.48
1:A:352:PHE:O	1:A:356:GLN:HG3	2.13	0.48
1:A:223:PHE:O	1:A:254:SER:HA	2.14	0.47
1:A:161:TYR:CE1	1:A:198:ILE:HD11	2.49	0.47
1:A:327:ARG:O	1:A:331:GLN:HG3	2.14	0.47
1:A:256:TYR:HD2	1:A:267:VAL:HG12	1.81	0.46
1:A:105:THR:HG21	1:A:111:ALA:CA	2.45	0.46
1:A:356:GLN:OE1	1:A:361:SER:HB2	2.16	0.46
1:A:355:LYS:HD3	1:A:355:LYS:HA	1.56	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:221:PHE:CD1	1:A:240:LEU:HD23	2.50	0.46
1:A:373:LEU:HD11	1:A:403:ALA:O	2.16	0.46
1:A:338:VAL:HG12	1:A:338:VAL:O	2.16	0.46
1:A:135:VAL:HG23	1:A:136:SER:O	2.16	0.45
1:A:68:LYS:HG2	3:A:600:HOH:O	2.16	0.45
1:A:24:PHE:CE1	1:A:34:ASN:HB2	2.52	0.45
1:A:37:ILE:CD1	1:A:41:LYS:HE2	2.47	0.45
1:A:377:PHE:CG	1:A:403:ALA:HB1	2.51	0.45
1:A:108:GLY:HA3	1:A:255:SER:HB2	1.97	0.45
1:A:91:GLY:HA3	3:A:548:HOH:O	2.17	0.45
1:A:37:ILE:HD13	1:A:41:LYS:HE2	1.99	0.45
1:A:29:ARG:O	1:A:32:LYS:HB2	2.17	0.44
1:A:168:LEU:HD11	1:A:173:LEU:HD12	1.98	0.44
1:A:105:THR:HG21	1:A:111:ALA:HB2	2.00	0.44
1:A:334:ARG:HG2	1:A:389:VAL:HG11	1.98	0.44
1:A:210:GLN:HG2	1:A:246:MET:HE1	1.99	0.44
1:A:15:ASP:N	1:A:16:PRO:HD2	2.32	0.44
1:A:98:LYS:HB3	1:A:98:LYS:HE2	1.76	0.43
1:A:121:LYS:HG2	1:A:122:ASN:ND2	2.32	0.43
1:A:75:GLY:HA3	1:A:104:GLN:HB3	2.00	0.43
1:A:161:TYR:HD1	1:A:198:ILE:HD12	1.83	0.43
1:A:167:THR:HG23	1:A:168:LEU:N	2.33	0.43
1:A:294:ASN:HD22	1:A:294:ASN:C	2.21	0.42
1:A:177:LEU:HB3	1:A:217:TRP:CH2	2.54	0.42
1:A:306:VAL:O	1:A:306:VAL:HG12	2.19	0.42
1:A:86:LEU:HD11	1:A:233:LEU:HD22	2.02	0.42
1:A:363:SER:HB2	1:A:365:LEU:HG	2.00	0.42
1:A:137:ASN:HB3	1:A:138:PRO:HD2	2.02	0.42
1:A:113:ARG:O	1:A:116:ALA:HB3	2.18	0.42
1:A:312:ASN:OD1	1:A:314:ALA:HB3	2.20	0.42
1:A:337:PHE:CE1	1:A:392:MET:HE2	2.55	0.42
1:A:330:ILE:HG21	1:A:358:GLY:O	2.20	0.41
1:A:25:ARG:NE	1:A:25:ARG:CA	2.71	0.41
1:A:402:GLU:HG2	3:A:535:HOH:O	2.19	0.41
1:A:76:ILE:H	1:A:104:GLN:HE21	1.69	0.41
1:A:81:ARG:O	1:A:85:GLU:HG3	2.20	0.41
1:A:302:GLY:O	1:A:306:VAL:HG23	2.21	0.41
1:A:247:HIS:HB2	1:A:250:LEU:HD23	2.03	0.41
1:A:260:PHE:HB3	1:A:262:LEU:HD12	2.03	0.41
1:A:277:SER:O	1:A:280:VAL:HG12	2.21	0.41
1:A:373:LEU:HD13	1:A:408:VAL:HG11	2.02	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:322:GLU:O	1:A:326:MET:HE3	2.21	0.40
1:A:15:ASP:N	1:A:16:PRO:CD	2.84	0.40
1:A:380:TYR:HD1	1:A:380:TYR:N	2.18	0.40
1:A:280:VAL:O	1:A:284:PHE:HB2	2.21	0.40
1:A:373:LEU:HA	1:A:373:LEU:HD12	1.82	0.40
1:A:76:ILE:HG13	1:A:104:GLN:NE2	2.33	0.40
1:A:189:HIS:CD2	1:A:194:ASN:H	2.40	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	394/396 (100%)	355 (90%)	28 (7%)	11 (3%)	<b>6</b> <b>5</b>

All (11) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	16	PRO
1	A	17	ILE
1	A	137	ASN
1	A	346	ALA
1	A	26	ALA
1	A	32	LYS
1	A	90	LYS
1	A	182	ALA
1	A	361	SER
1	A	136	SER
1	A	195	PRO

### 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	320/320 (100%)	281 (88%)	39 (12%)	<b>6</b> <b>7</b>

All (39) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	5	MET
1	A	7	GLU
1	A	16	PRO
1	A	20	LEU
1	A	23	LEU
1	A	25	ARG
1	A	53	VAL
1	A	61	LEU
1	A	90	LYS
1	A	105	THR
1	A	113	ARG
1	A	119	LEU
1	A	143	HIS
1	A	167	THR
1	A	202	LEU
1	A	210	GLN
1	A	212	SER
1	A	223	PHE
1	A	235	GLU
1	A	240	LEU
1	A	246	MET
1	A	252	VAL
1	A	259	ASN
1	A	273	VAL
1	A	277	SER
1	A	294	ASN
1	A	297	ASN
1	A	298	PRO
1	A	304	SER
1	A	315	LEU

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Mol	Chain	Res	Type
1	A	323	LEU
1	A	341	LEU
1	A	342	GLN
1	A	349	ASP
1	A	372	ARG
1	A	373	LEU
1	A	374	ARG
1	A	380	TYR
1	A	409	LEU

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

Mol	Chain	Res	Type
1	A	8	ASN
1	A	96	ASN
1	A	104	GLN
1	A	122	ASN
1	A	137	ASN
1	A	148	ASN
1	A	175	ASN
1	A	178	ASN
1	A	189	HIS
1	A	204	GLN
1	A	210	GLN
1	A	259	ASN
1	A	294	ASN
1	A	297	ASN
1	A	339	ASN
1	A	347	ASN

### 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 carbohydrates 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	PLP	A	458	1	15,15,16	2.56	5 (33%)	21,22,23	2.40	8 (38%)

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	PLP	A	458	1	-	0/6/6/8	0/1/1/1

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	458	PLP	O4P-C5A	-6.73	1.16	1.44
2	A	458	PLP	C4A-C4	-3.66	1.44	1.51
2	A	458	PLP	P-O4P	-3.48	1.48	1.60
2	A	458	PLP	P-O3P	-3.42	1.42	1.54
2	A	458	PLP	P-O1P	-2.23	1.43	1.51

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	458	PLP	O4P-P-O1P	-6.14	91.52	107.14
2	A	458	PLP	C5-C6-N1	-2.73	119.13	123.86
2	A	458	PLP	C3-C2-N1	-2.40	117.30	120.61
2	A	458	PLP	C3-C4-C5	-2.35	116.22	118.78

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Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
2	A	458	PLP	C6-N1-C2	2.05	123.46	119.28
2	A	458	PLP	C4A-C4-C5	2.42	123.40	120.88
2	A	458	PLP	O2P-P-O4P	3.33	116.15	106.56
2	A	458	PLP	C6-C5-C4	4.29	121.78	118.15

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 [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](#)

EDS was not executed - this section will therefore be empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

EDS was not executed - this section will therefore be empty.

### 6.3 Carbohydrates [i](#)

EDS was not executed - this section will therefore be empty.

### 6.4 Ligands [i](#)

EDS was not executed - this section will therefore be empty.

### 6.5 Other polymers [i](#)

EDS was not executed - this section will therefore be empty.