



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 28, 2026 – 06:57 AM UTC

PDB ID : 4TVV / pdb_00004tvv
Title : Crystal structure of LppA from Legionella pneumophila
Authors : Weber, S.; Stirnimann, C.; Wieser, M.; Meier, R.; Engelhardt, S.; Li, X.; Capitani, G.; Kammerer, R.; Hilbi, H.
Deposited on : 2014-06-28
Resolution : 1.40 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)	:	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

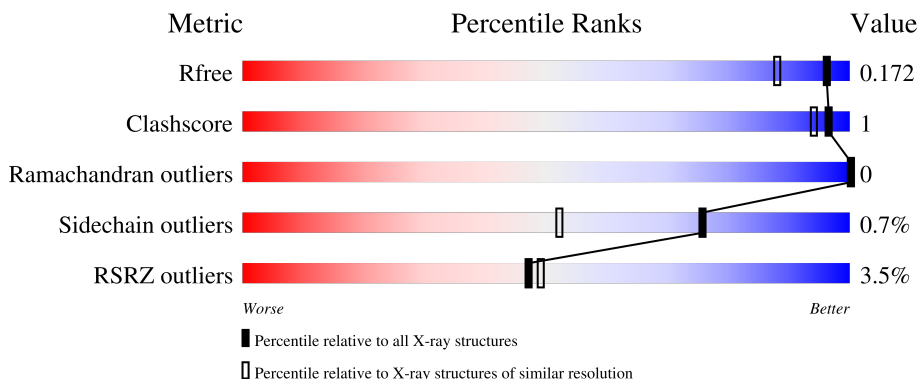
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.40 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))
R_{free}	180053	2563 (1.40-1.40)
Clashscore	190562	2660 (1.40-1.40)
Ramachandran outliers	187476	2611 (1.40-1.40)
Sidechain outliers	187428	2610 (1.40-1.40)
RSRZ outliers	180081	2561 (1.40-1.40)

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 $\leq 5\%$. 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	% 88% 9%
1	B	314	 91% 8%
1	C	314	9% 87% 10%
1	D	314	3% 89% 8%

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 20231 atoms, of which 9314 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 Tyrosine phosphatase II superfamily protein.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	285	Total	C	H	N	O	S	0	10	0
			4703	1508	2340	401	443	11			
1	B	288	Total	C	H	N	O	S	0	6	0
			4651	1492	2311	396	441	11			
1	C	284	Total	C	H	N	O	S	0	7	0
			4632	1487	2304	394	436	11			
1	D	288	Total	C	H	N	O	S	0	8	0
			4702	1507	2339	401	444	11			

There are 60 discrepancies between the modelled and reference sequences:

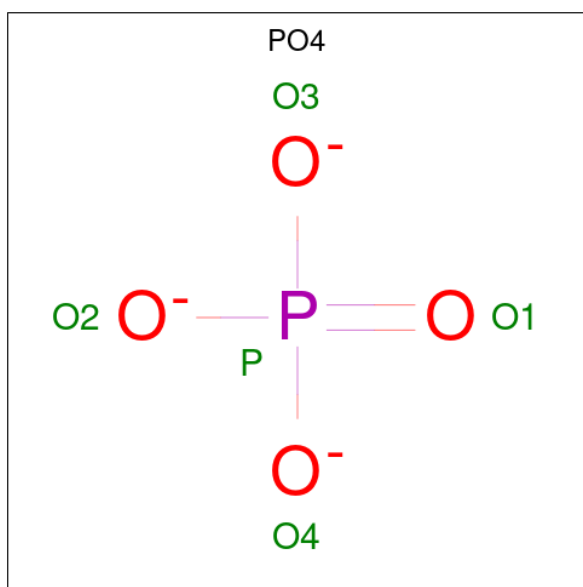
Chain	Residue	Modelled	Actual	Comment	Reference
A	6	MET	-	initiating methionine	UNP Q5ZRR1
A	7	LYS	-	expression tag	UNP Q5ZRR1
A	8	LYS	-	expression tag	UNP Q5ZRR1
A	9	ASN	-	expression tag	UNP Q5ZRR1
A	10	HIS	-	expression tag	UNP Q5ZRR1
A	11	HIS	-	expression tag	UNP Q5ZRR1
A	12	HIS	-	expression tag	UNP Q5ZRR1
A	13	HIS	-	expression tag	UNP Q5ZRR1
A	14	HIS	-	expression tag	UNP Q5ZRR1
A	15	HIS	-	expression tag	UNP Q5ZRR1
A	16	LEU	-	expression tag	UNP Q5ZRR1
A	17	VAL	-	expression tag	UNP Q5ZRR1
A	18	PRO	-	expression tag	UNP Q5ZRR1
A	19	ARG	-	expression tag	UNP Q5ZRR1
A	20	GLY	-	expression tag	UNP Q5ZRR1
B	6	MET	-	initiating methionine	UNP Q5ZRR1
B	7	LYS	-	expression tag	UNP Q5ZRR1
B	8	LYS	-	expression tag	UNP Q5ZRR1
B	9	ASN	-	expression tag	UNP Q5ZRR1
B	10	HIS	-	expression tag	UNP Q5ZRR1
B	11	HIS	-	expression tag	UNP Q5ZRR1

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Chain	Residue	Modelled	Actual	Comment	Reference
B	12	HIS	-	expression tag	UNP Q5ZRR1
B	13	HIS	-	expression tag	UNP Q5ZRR1
B	14	HIS	-	expression tag	UNP Q5ZRR1
B	15	HIS	-	expression tag	UNP Q5ZRR1
B	16	LEU	-	expression tag	UNP Q5ZRR1
B	17	VAL	-	expression tag	UNP Q5ZRR1
B	18	PRO	-	expression tag	UNP Q5ZRR1
B	19	ARG	-	expression tag	UNP Q5ZRR1
B	20	GLY	-	expression tag	UNP Q5ZRR1
C	6	MET	-	initiating methionine	UNP Q5ZRR1
C	7	LYS	-	expression tag	UNP Q5ZRR1
C	8	LYS	-	expression tag	UNP Q5ZRR1
C	9	ASN	-	expression tag	UNP Q5ZRR1
C	10	HIS	-	expression tag	UNP Q5ZRR1
C	11	HIS	-	expression tag	UNP Q5ZRR1
C	12	HIS	-	expression tag	UNP Q5ZRR1
C	13	HIS	-	expression tag	UNP Q5ZRR1
C	14	HIS	-	expression tag	UNP Q5ZRR1
C	15	HIS	-	expression tag	UNP Q5ZRR1
C	16	LEU	-	expression tag	UNP Q5ZRR1
C	17	VAL	-	expression tag	UNP Q5ZRR1
C	18	PRO	-	expression tag	UNP Q5ZRR1
C	19	ARG	-	expression tag	UNP Q5ZRR1
C	20	GLY	-	expression tag	UNP Q5ZRR1
D	6	MET	-	initiating methionine	UNP Q5ZRR1
D	7	LYS	-	expression tag	UNP Q5ZRR1
D	8	LYS	-	expression tag	UNP Q5ZRR1
D	9	ASN	-	expression tag	UNP Q5ZRR1
D	10	HIS	-	expression tag	UNP Q5ZRR1
D	11	HIS	-	expression tag	UNP Q5ZRR1
D	12	HIS	-	expression tag	UNP Q5ZRR1
D	13	HIS	-	expression tag	UNP Q5ZRR1
D	14	HIS	-	expression tag	UNP Q5ZRR1
D	15	HIS	-	expression tag	UNP Q5ZRR1
D	16	LEU	-	expression tag	UNP Q5ZRR1
D	17	VAL	-	expression tag	UNP Q5ZRR1
D	18	PRO	-	expression tag	UNP Q5ZRR1
D	19	ARG	-	expression tag	UNP Q5ZRR1
D	20	GLY	-	expression tag	UNP Q5ZRR1

- Molecule 2 is PHOSPHATE ION (CCD ID: PO4) (formula: O₄P).



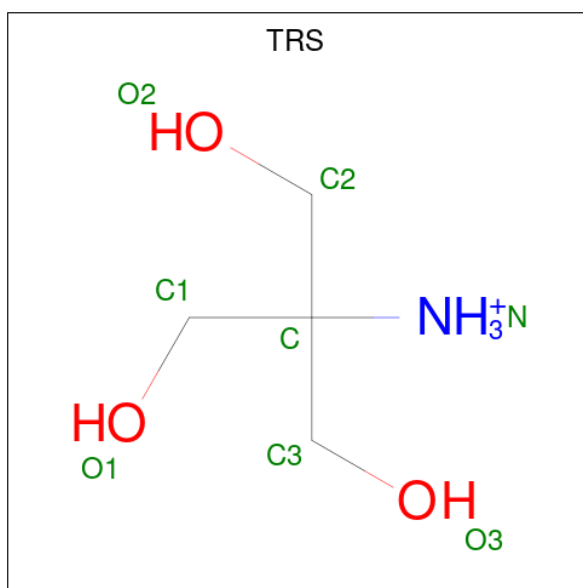
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	P	0	0
			5	4	1		
2	A	1	Total	O	P	0	0
			5	4	1		
2	B	1	Total	O	P	0	0
			5	4	1		
2	B	1	Total	O	P	0	0
			5	4	1		
2	C	1	Total	O	P	0	0
			5	4	1		
2	C	1	Total	O	P	0	0
			5	4	1		
2	D	1	Total	O	P	0	0
			5	4	1		
2	D	1	Total	O	P	0	0
			5	4	1		

- Molecule 3 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	Cl	0	0
			2	2		
3	B	2	Total	Cl	0	0
			2	2		
3	C	1	Total	Cl	0	0
			1	1		

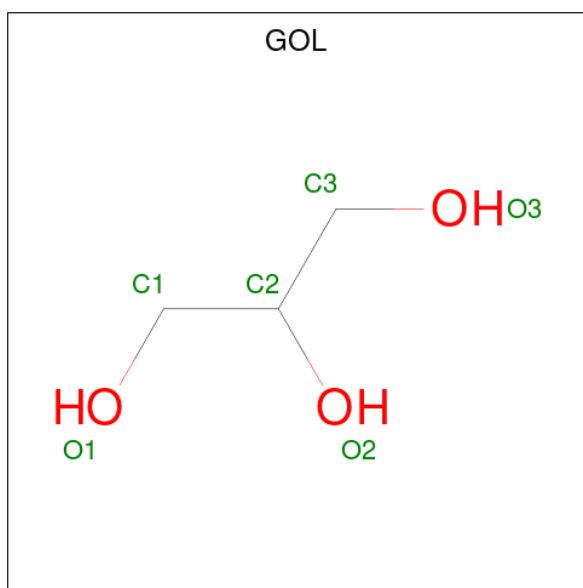
- Molecule 4 is 2-AMINO-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (CCD ID: TRS)

(formula: $C_4H_{12}NO_3$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	B	1	Total	C	H	N	O	0	0
			20	4	12	1	3		

- Molecule 5 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).

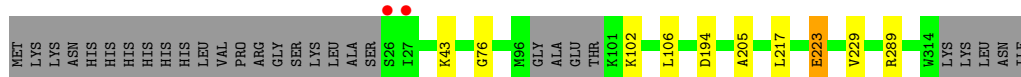


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	B	1	Total	C	H	O		
			14	3	8	3	0	0

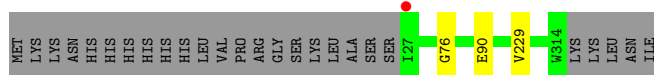
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	404	Total 404	O 404	0	0
6	B	480	Total 480	O 480	0	0
6	C	253	Total 253	O 253	0	0
6	D	327	Total 327	O 327	0	0

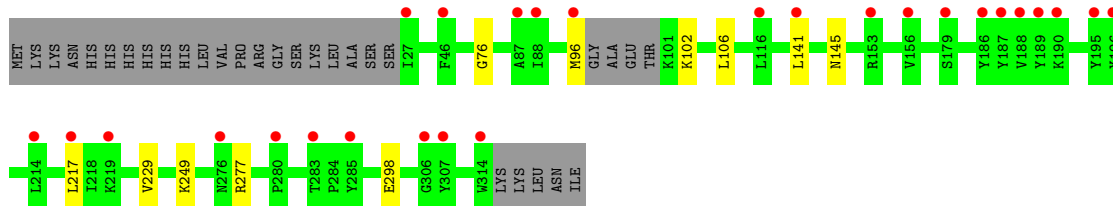
- Molecule 1: Tyrosine phosphatase II superfamily protein

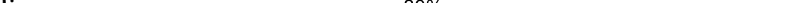


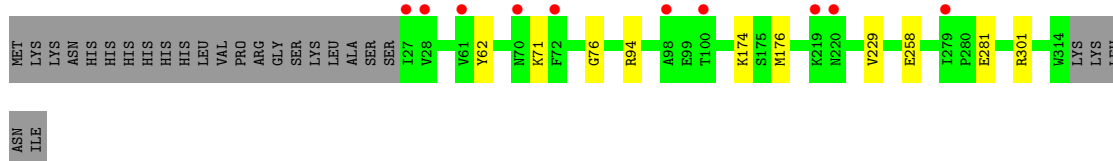
Chain B: 91% • 8%



Chain C:  9% 87% 10%



Chain D:  3% 89% 8%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	98.65Å 55.49Å 131.42Å 90.00° 99.61° 90.00°	Depositor
Resolution (Å)	48.26 – 1.40 48.26 – 1.40	Depositor EDS
% Data completeness (in resolution range)	95.9 (48.26-1.40) 96.0 (48.26-1.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.86 (at 1.40Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.9_1692)	Depositor
R, R_{free}	0.143 , 0.169 0.148 , 0.172	Depositor DCC
R_{free} test set	1060 reflections (0.40%)	wwPDB-VP
Wilson B-factor (Å ²)	16.5	Xtriage
Anisotropy	0.516	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 41.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	20231	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 59.41 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.7723e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CL, PO4, GOL, TRS

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	0/2438	0.68	0/3300
1	B	0.49	0/2413	0.68	0/3269
1	C	0.44	0/2403	0.68	0/3254
1	D	0.46	0/2439	0.68	0/3302
All	All	0.48	0/9693	0.68	0/13125

There are no bond length outliers.

There are no bond angle outliers.

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	2363	2340	2333	6	0
1	B	2340	2311	2305	2	0
1	C	2328	2304	2299	7	0
1	D	2363	2339	2335	4	0
2	A	10	0	0	0	0
2	B	10	0	0	0	0
2	C	10	0	0	0	0
2	D	10	0	0	0	0
3	A	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	2	0	0	0	0
3	C	1	0	0	0	0
4	B	8	12	12	0	0
5	B	6	8	8	0	0
6	A	404	0	0	2	0
6	B	480	0	0	1	0
6	C	253	0	0	4	0
6	D	327	0	0	1	0
All	All	10917	9314	9292	19	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 1.

The worst 5 of 19 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:102:LYS:NZ	1:A:194:ASP:OD2	2.22	0.68
1:A:43:LYS:NZ	6:A:803:HOH:O	2.27	0.64
1:A:106[A]:LEU:HD21	1:A:217:LEU:HD21	1.90	0.54
1:C:298:GLU:OE1	6:C:501:HOH:O	2.19	0.53
1:B:90:GLU:OE1	6:B:970:HOH:O	2.19	0.53

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	292/314 (93%)	286 (98%)	6 (2%)	0	100	100
1	B	292/314 (93%)	286 (98%)	6 (2%)	0	100	100
1	C	288/314 (92%)	282 (98%)	6 (2%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	D	295/314 (94%)	290 (98%)	5 (2%)	0	100	100
All	All	1167/1256 (93%)	1144 (98%)	23 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	263/277 (95%)	262 (100%)	1 (0%)	84	67
1	B	259/277 (94%)	259 (100%)	0	100	100
1	C	259/277 (94%)	256 (99%)	3 (1%)	63	34
1	D	262/277 (95%)	259 (99%)	3 (1%)	65	37
All	All	1043/1108 (94%)	1036 (99%)	7 (1%)	76	52

5 of 7 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	141	LEU
1	D	71	LYS
1	D	301	ARG
1	D	281	GLU
1	C	102	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	157	ASN
1	C	288	GLN
1	D	138	GLN
1	B	136	ASN
1	A	157	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 oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 15 ligands modelled in this entry, 5 are monoatomic - leaving 10 for Mogul analysis.

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	PO4	B	402	-	4,4,4	0.95	0	6,6,6	0.88	0
2	PO4	D	402	-	4,4,4	0.73	0	6,6,6	0.80	0
2	PO4	C	401	-	4,4,4	1.27	0	6,6,6	0.95	0
4	TRS	B	403	-	7,7,7	0.31	0	9,9,9	0.40	0
2	PO4	B	401	-	4,4,4	0.84	0	6,6,6	0.55	0
2	PO4	A	402	-	4,4,4	0.95	0	6,6,6	1.32	1 (16%)
5	GOL	B	406	-	5,5,5	0.36	0	5,5,5	0.38	0
2	PO4	A	401	-	4,4,4	0.72	0	6,6,6	0.52	0
2	PO4	C	402	-	4,4,4	0.93	0	6,6,6	0.55	0
2	PO4	D	401	-	4,4,4	1.08	0	6,6,6	0.61	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	TRS	B	403	-	-	0/9/9/9	-
5	GOL	B	406	-	-	0/4/4/4	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	A	402	PO4	O4-P-O2	2.11	114.47	107.91

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](#)

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	285/314 (90%)	-0.39	2 (0%) 84 87	7, 18, 36, 50	10 (3%)
1	B	288/314 (91%)	-0.42	1 (0%) 90 92	9, 18, 32, 49	6 (2%)
1	C	284/314 (90%)	0.68	27 (9%) 14 13	11, 32, 48, 62	7 (2%)
1	D	288/314 (91%)	0.09	10 (3%) 47 49	11, 28, 45, 52	9 (3%)
All	All	1145/1256 (91%)	-0.01	40 (3%) 47 49	7, 23, 44, 62	32 (2%)

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	27	ILE	4.6
1	C	188	VAL	4.4
1	D	27	ILE	4.3
1	C	214	LEU	4.0
1	B	27	ILE	3.9

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](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q < 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
5	GOL	B	406	6/6	0.94	0.09	16,20,21,22	14
2	PO4	B	402	5/5	0.97	0.06	12,13,15,15	5
2	PO4	C	402	5/5	0.98	0.06	19,22,22,24	0
2	PO4	D	401	5/5	0.98	0.06	24,25,26,26	0
2	PO4	D	402	5/5	0.98	0.06	21,22,24,26	0
2	PO4	C	401	5/5	0.98	0.05	19,20,21,23	0
2	PO4	A	401	5/5	0.99	0.05	14,14,15,15	0
2	PO4	A	402	5/5	0.99	0.03	12,13,13,16	0
3	CL	A	403	1/1	0.99	0.03	25,25,25,25	0
3	CL	A	404	1/1	0.99	0.05	30,30,30,30	0
3	CL	C	403	1/1	0.99	0.04	33,33,33,33	0
4	TRS	B	403	8/8	0.99	0.04	15,18,21,23	0
2	PO4	B	401	5/5	0.99	0.04	16,16,16,18	0
3	CL	B	405	1/1	1.00	0.04	29,29,29,29	0
3	CL	B	404	1/1	1.00	0.07	21,21,21,21	0

6.5 Other polymers [i](#)

There are no such residues in this entry.