



wwPDB X-ray Structure Validation Summary Report ⓘ

May 24, 2020 – 05:20 pm BST

PDB ID : 5ZON
Title : Histidinol phosphate phosphatase from Mycobacterium tuberculosis
Authors : Jha, B.; Kumar, D.; Biswal, B.K.
Deposited on : 2018-04-13
Resolution : 1.94 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

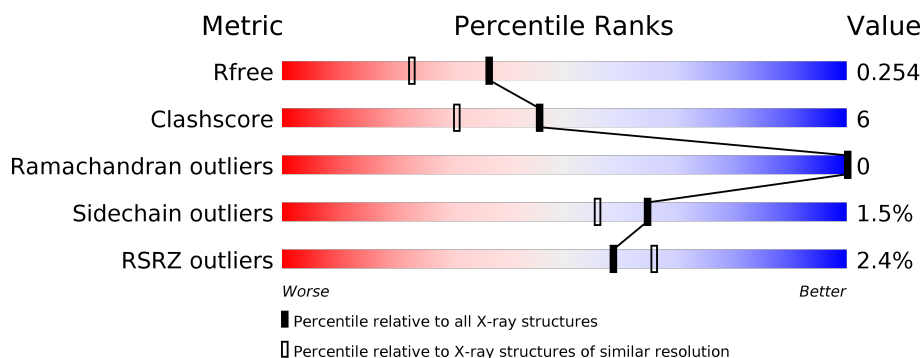
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.94 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}	130704	4310 (1.96-1.92)
Clashscore	141614	1023 (1.94-1.94)
Ramachandran outliers	138981	1007 (1.94-1.94)
Sidechain outliers	138945	1007 (1.94-1.94)
RSRZ outliers	127900	4250 (1.96-1.92)

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 ≥ 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	267	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red 1%, orange 1%, yellow 13%, green 82%, grey 6%);"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> % 82% 13% • • </div> </div>
1	B	267	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red 3%, orange 1%, yellow 9%, green 83%, grey 7%);"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> 3% 83% 9% • 7% </div> </div>
1	C	267	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red 1%, orange 1%, yellow 13%, green 82%, grey 6%);"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> % 82% 13% • • </div> </div>
1	D	267	<div> <div style="width: 100%; height: 10px; background: linear-gradient(to right, red 4%, orange 1%, yellow 8%, green 83%, grey 7%);"></div> <div style="display: flex; justify-content: space-between; width: 100%;"> 4% 83% 8% • 7% </div> </div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	PO4	A	303	-	-	X	-
4	GOL	C	306	-	-	X	-

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 8456 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 Histidinol-phosphatase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	256	Total	C	N	O	S	0	2	0
			1911	1206	342	362	1			
1	B	247	Total	C	N	O	S	0	1	0
			1816	1148	325	342	1			
1	C	256	Total	C	N	O	S	0	2	0
			1903	1204	339	358	2			
1	D	247	Total	C	N	O	S	0	1	0
			1795	1138	320	336	1			

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	MET	-	initiating methionine	UNP P95189
A	-5	HIS	-	expression tag	UNP P95189
A	-4	HIS	-	expression tag	UNP P95189
A	-3	HIS	-	expression tag	UNP P95189
A	-2	HIS	-	expression tag	UNP P95189
A	-1	HIS	-	expression tag	UNP P95189
A	0	HIS	-	expression tag	UNP P95189
A	1	VAL	-	expression tag	UNP P95189
B	-6	MET	-	initiating methionine	UNP P95189
B	-5	HIS	-	expression tag	UNP P95189
B	-4	HIS	-	expression tag	UNP P95189
B	-3	HIS	-	expression tag	UNP P95189
B	-2	HIS	-	expression tag	UNP P95189
B	-1	HIS	-	expression tag	UNP P95189
B	0	HIS	-	expression tag	UNP P95189
B	1	VAL	-	expression tag	UNP P95189
C	-6	MET	-	initiating methionine	UNP P95189
C	-5	HIS	-	expression tag	UNP P95189
C	-4	HIS	-	expression tag	UNP P95189
C	-3	HIS	-	expression tag	UNP P95189
C	-2	HIS	-	expression tag	UNP P95189

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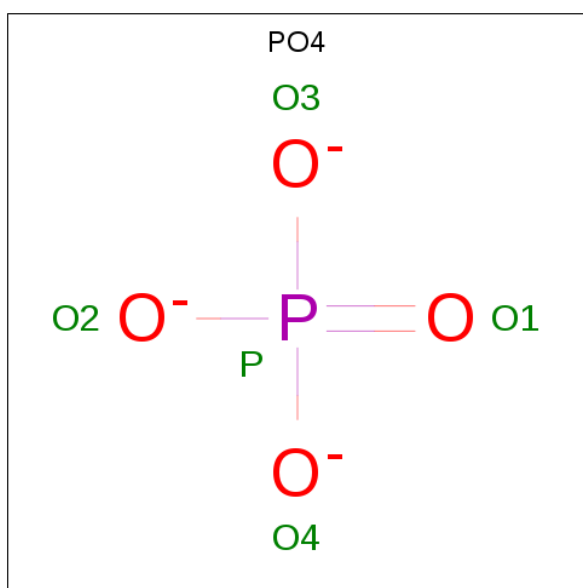
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Chain	Residue	Modelled	Actual	Comment	Reference
C	-1	HIS	-	expression tag	UNP P95189
C	0	HIS	-	expression tag	UNP P95189
C	1	VAL	-	expression tag	UNP P95189
D	-6	MET	-	initiating methionine	UNP P95189
D	-5	HIS	-	expression tag	UNP P95189
D	-4	HIS	-	expression tag	UNP P95189
D	-3	HIS	-	expression tag	UNP P95189
D	-2	HIS	-	expression tag	UNP P95189
D	-1	HIS	-	expression tag	UNP P95189
D	0	HIS	-	expression tag	UNP P95189
D	1	VAL	-	expression tag	UNP P95189

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

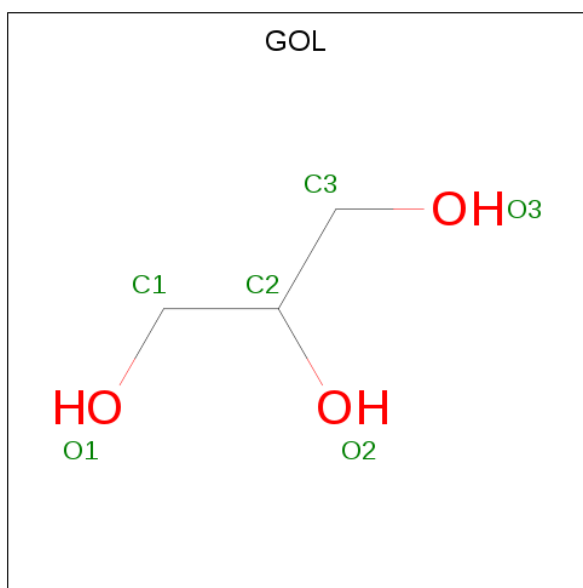
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	B	2	Total Zn 2 2	0	0
2	A	2	Total Zn 2 2	0	0
2	D	2	Total Zn 2 2	0	0
2	C	2	Total Zn 2 2	0	0

- Molecule 3 is PHOSPHATE ION (three-letter code: PO4) (formula: O₄P).



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

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



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

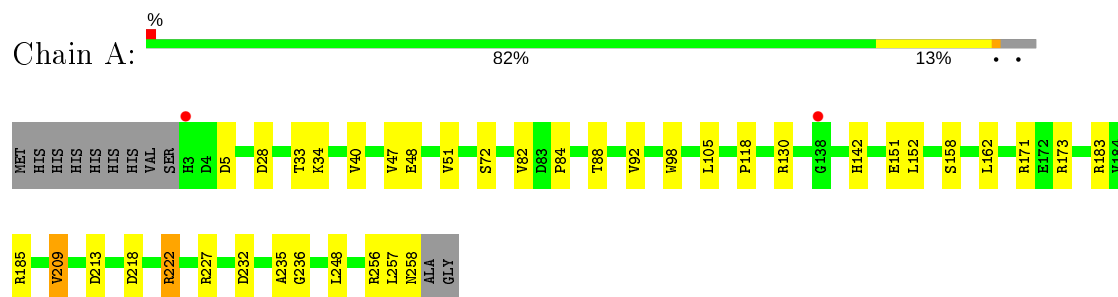
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	264	Total 264	O 264	0	0
5	B	232	Total 232	O 232	0	0
5	C	260	Total 260	O 260	0	0
5	D	215	Total 215	O 215	0	0

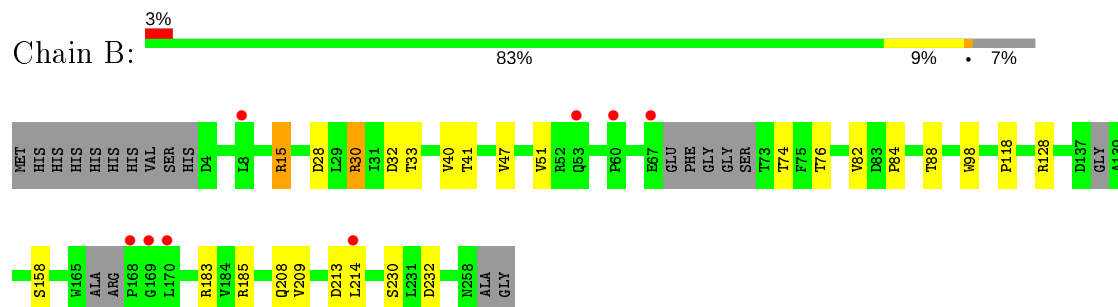
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

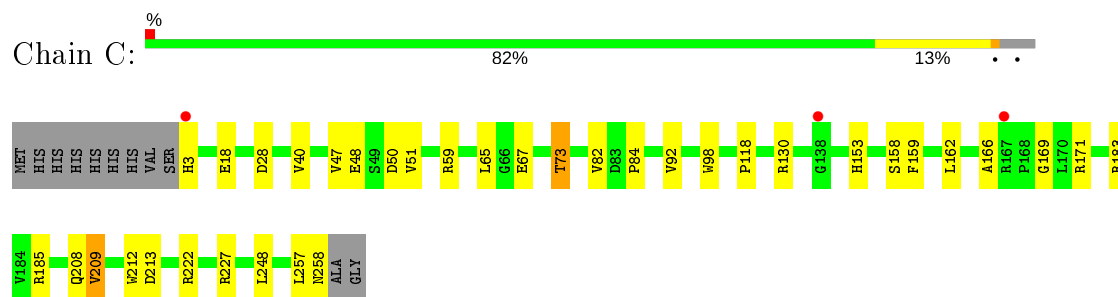
- Molecule 1: Histidinol-phosphatase



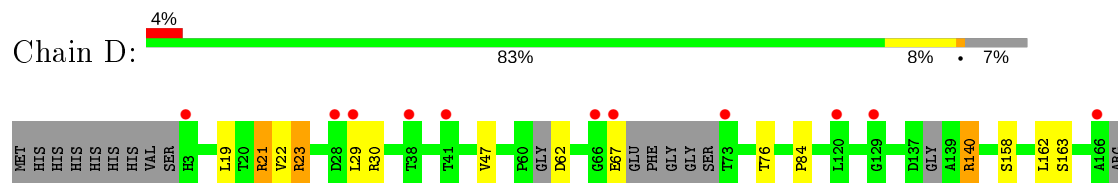
- Molecule 1: Histidinol-phosphatase

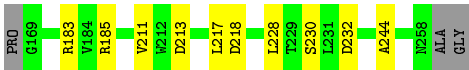


- Molecule 1: Histidinol-phosphatase



- Molecule 1: Histidinol-phosphatase





4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	49.03Å 71.06Å 91.59Å 92.16° 96.16° 101.94°	Depositor
Resolution (Å)	38.50 – 1.94 38.47 – 1.94	Depositor EDS
% Data completeness (in resolution range)	97.0 (38.50-1.94) 97.1 (38.47-1.94)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.47 (at 1.95Å)	Xtriage
Refinement program	REFMAC 5.8.0222	Depositor
R, R_{free}	0.212 , 0.254 0.212 , 0.254	Depositor DCC
R_{free} test set	4257 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	19.8	Xtriage
Anisotropy	0.175	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 55.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	8456	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 18.17% 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 [i](#)

5.1 Standard geometry [i](#)

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

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	0.58	0/1954	0.78	2/2661 (0.1%)
1	B	0.51	0/1851	0.74	0/2519
1	C	0.59	0/1947	0.79	0/2654
1	D	0.52	0/1828	0.73	0/2491
All	All	0.55	0/7580	0.76	2/10325 (0.0%)

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
1	B	0	4
1	C	0	2
1	D	0	2
All	All	0	10

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	222[A]	ARG	CB-CG-CD	5.02	124.65	111.60
1	A	222[B]	ARG	CB-CG-CD	5.02	124.65	111.60

There are no chirality outliers.

5 of 10 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	183	ARG	Sidechain
1	A	227	ARG	Sidechain
1	B	128	ARG	Sidechain
1	B	15	ARG	Sidechain
1	B	30	ARG	Sidechain

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	1911	0	1876	27	0
1	B	1816	0	1764	17	0
1	C	1903	0	1867	30	0
1	D	1795	0	1743	20	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
2	C	2	0	0	0	0
2	D	2	0	0	0	0
3	A	5	0	0	2	0
3	B	15	0	0	1	0
3	C	10	0	0	0	0
3	D	10	0	0	0	0
4	C	12	0	16	7	0
5	A	264	0	0	11	0
5	B	232	0	0	8	0
5	C	260	0	0	13	0
5	D	215	0	0	12	0
All	All	8456	0	7266	95	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 6.

The worst 5 of 95 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)
5:C:434:HOH:O	1:D:163:SER:HB3	1.47	1.15
1:C:73:THR:HG21	5:C:594:HOH:O	1.67	0.91

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:21:ARG:HD3	5:D:492:HOH:O	1.72	0.89
1:C:208:GLN:HG2	5:C:644:HOH:O	1.70	0.89
1:D:211:VAL:HG21	5:D:463:HOH:O	1.80	0.81

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	256/267 (96%)	248 (97%)	8 (3%)	0	100	100
1	B	240/267 (90%)	232 (97%)	8 (3%)	0	100	100
1	C	256/267 (96%)	246 (96%)	10 (4%)	0	100	100
1	D	238/267 (89%)	230 (97%)	8 (3%)	0	100	100
All	All	990/1068 (93%)	956 (97%)	34 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	190/208 (91%)	186 (98%)	4 (2%)	53	41
1	B	179/208 (86%)	179 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	191/208 (92%)	187 (98%)	4 (2%)	53	41
1	D	174/208 (84%)	171 (98%)	3 (2%)	60	49
All	All	734/832 (88%)	723 (98%)	11 (2%)	65	56

5 of 11 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	18	GLU
1	C	50	ASP
1	D	23	ARG
1	A	209	VAL
1	C	209	VAL

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	C	153	HIS
1	C	238	HIS

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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 18 ligands modelled in this entry, 8 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
3	PO4	A	303	2	4,4,4	1.21	0	6,6,6	1.05	0
3	PO4	D	303	-	4,4,4	0.61	0	6,6,6	1.38	1 (16%)
3	PO4	C	304	2	4,4,4	0.54	0	6,6,6	0.52	0
4	GOL	C	305	-	5,5,5	0.77	0	5,5,5	0.59	0
3	PO4	B	301	-	4,4,4	0.97	0	6,6,6	1.04	0
4	GOL	C	306	-	5,5,5	0.22	0	5,5,5	0.65	0
3	PO4	B	305	-	4,4,4	1.27	0	6,6,6	1.13	0
3	PO4	D	304	-	4,4,4	1.12	0	6,6,6	0.60	0
3	PO4	B	304	2	4,4,4	0.65	0	6,6,6	0.78	0
3	PO4	C	303	-	4,4,4	1.02	0	6,6,6	0.55	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	GOL	C	305	-	-	4/4/4/4	-
4	GOL	C	306	-	-	4/4/4/4	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	303	PO4	O4-P-O2	2.60	116.31	107.97

There are no chirality outliers.

5 of 8 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	C	305	GOL	O1-C1-C2-C3
4	C	305	GOL	C1-C2-C3-O3
4	C	306	GOL	O1-C1-C2-C3
4	C	305	GOL	O1-C1-C2-O2
4	C	305	GOL	O2-C2-C3-O3

There are no ring outliers.

3 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	303	PO4	2	0
4	C	306	GOL	7	0
3	B	305	PO4	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 ⓘ

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	256/267 (95%)	0.09	2 (0%) 86 89	13, 22, 40, 55	0
1	B	247/267 (92%)	0.47	8 (3%) 47 55	15, 29, 49, 76	0
1	C	256/267 (95%)	0.15	3 (1%) 79 83	12, 22, 38, 56	0
1	D	247/267 (92%)	0.50	11 (4%) 33 40	14, 27, 48, 73	0
All	All	1006/1068 (94%)	0.30	24 (2%) 59 66	12, 25, 45, 76	0

The worst 5 of 24 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	166	ALA	6.6
1	D	38	THR	5.2
1	B	168	PRO	4.2
1	D	129	GLY	3.7
1	D	29	LEU	3.4

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 ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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(\AA^2)	Q<0.9
3	PO4	D	303	5/5	0.77	0.15	46,48,67,68	0
4	GOL	C	305	6/6	0.85	0.17	32,37,37,43	0
4	GOL	C	306	6/6	0.86	0.20	45,51,56,58	0
3	PO4	B	304	5/5	0.87	0.16	45,50,62,64	1
2	ZN	B	303	1/1	0.90	0.07	56,56,56,56	0
2	ZN	D	302	1/1	0.90	0.06	63,63,63,63	0
3	PO4	D	304	5/5	0.91	0.10	48,52,55,56	0
3	PO4	B	305	5/5	0.94	0.12	45,50,54,58	0
3	PO4	C	303	5/5	0.94	0.10	44,45,49,54	0
3	PO4	C	304	5/5	0.96	0.14	29,32,35,39	1
3	PO4	B	301	5/5	0.96	0.09	47,47,49,50	1
3	PO4	A	303	5/5	0.97	0.10	31,32,38,42	0
2	ZN	B	302	1/1	0.97	0.04	42,42,42,42	0
2	ZN	D	301	1/1	0.97	0.06	42,42,42,42	1
2	ZN	C	301	1/1	0.99	0.08	10,10,10,10	0
2	ZN	C	302	1/1	1.00	0.07	11,11,11,11	0
2	ZN	A	302	1/1	1.00	0.07	10,10,10,10	0
2	ZN	A	301	1/1	1.00	0.06	11,11,11,11	0

6.5 Other polymers ⓘ

There are no such residues in this entry.