



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 26, 2018 – 04:01 PM EST

PDB ID : 3ZVM
Title : The structural basis for substrate recognition by mammalian polynucleotide kinase 3' phosphatase
Authors : Garces, F.; Pearl, L.H.; Oliver, A.W.
Deposited on : 2011-07-25
Resolution : 2.00 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

<http://wwpdb.org/validation/2016/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 : 1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20030736
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20030736

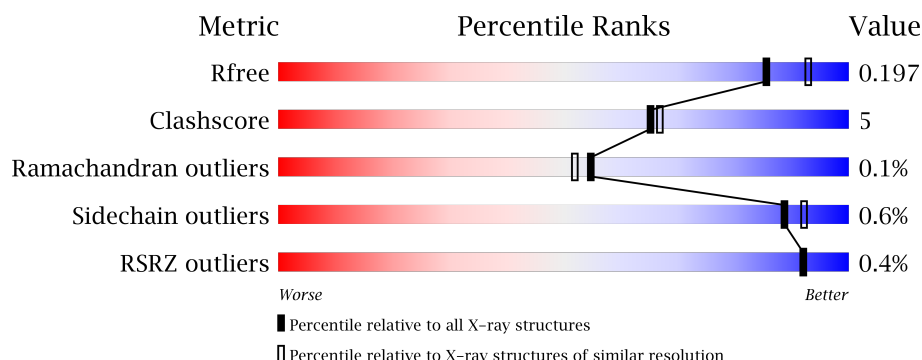
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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}	100719	6609 (2.00-2.00)
Clashscore	112137	7775 (2.00-2.00)
Ramachandran outliers	110173	7679 (2.00-2.00)
Sidechain outliers	110143	7678 (2.00-2.00)
RSRZ outliers	101464	6696 (2.00-2.00)

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. 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	416	
1	B	416	
2	E	5	
2	F	5	

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
5	MG	A	1525	-	-	-	X
5	MG	B	1525	-	-	-	X
6	GOL	A	1527	-	-	-	X
6	GOL	A	1528	-	-	-	X
6	GOL	A	1529	-	-	-	X
6	GOL	A	1530	-	-	-	X
6	GOL	B	1527	-	-	-	X
6	GOL	B	1528	-	-	-	X
6	GOL	B	1529	-	-	X	X
6	GOL	B	1530	-	-	-	X

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 7426 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 BIFUNCTIONAL POLYNUCLEOTIDE PHOSPHATASE/KINASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	380	Total	C	N	O	S	0	5	0
			2991	1920	521	538	12			
1	B	379	Total	C	N	O	S	0	4	0
			2979	1907	518	542	12			

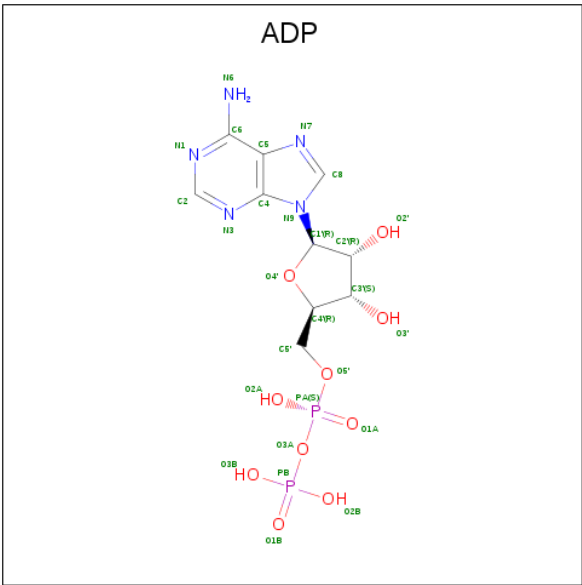
There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	107	GLY	-	expression tag	UNP Q9JLV6
A	108	PRO	-	expression tag	UNP Q9JLV6
A	109	HIS	-	expression tag	UNP Q9JLV6
A	110	MET	-	expression tag	UNP Q9JLV6
B	107	GLY	-	expression tag	UNP Q9JLV6
B	108	PRO	-	expression tag	UNP Q9JLV6
B	109	HIS	-	expression tag	UNP Q9JLV6
B	110	MET	-	expression tag	UNP Q9JLV6

- Molecule 2 is a DNA chain called 5'-D(*GP*TP*CP*AP*CP)-3'.

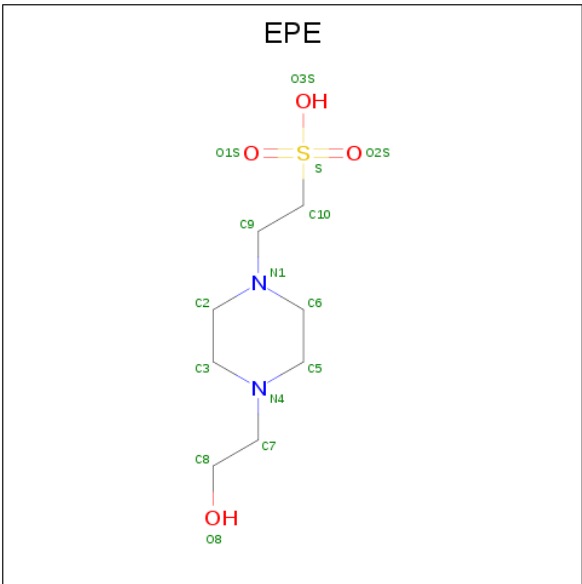
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	4	Total	C	N	O	P	0	0	1
			61	29	11	18	3			
2	F	3	Total	C	N	O	P	0	0	0
			55	28	11	14	2			

- Molecule 3 is ADENOSINE-5'-DIPHOSPHATE (three-letter code: ADP) (formula: C₁₀H₁₅N₅O₁₀P₂).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	N	O	P	0	0
			27	10	5	10	2		
3	B	1	Total	C	N	O	P	0	0
			27	10	5	10	2		

- Molecule 4 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (three-letter code: EPE) (formula: C₈H₁₈N₂O₄S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	S	0	0
			15	8	2	4	1		

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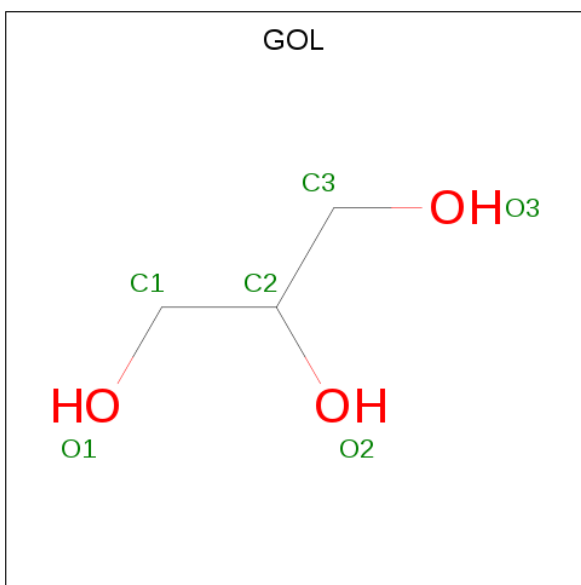
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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	B	1	Total	C	N	O	S	0	0
			15	8	2	4	1		

- Molecule 5 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	B	2	Total	Mg	0	0
			2	2		
5	A	2	Total	Mg	0	0
			2	2		

- Molecule 6 is GLYCEROL (three-letter code: GOL) (formula: C₃H₈O₃).



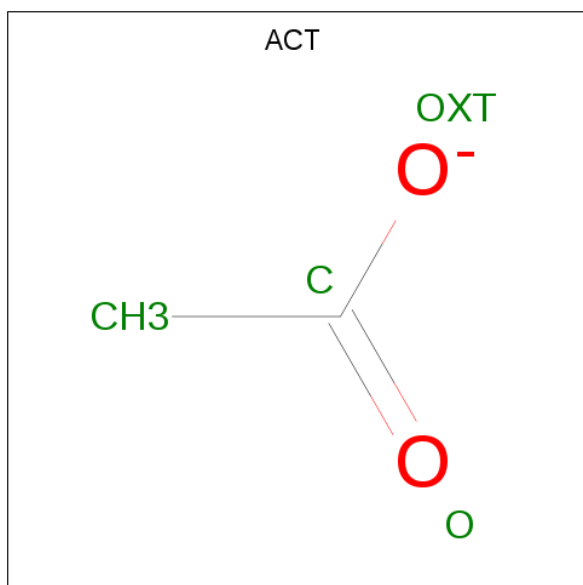
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	C	O	0	0
			6	3	3		
6	A	1	Total	C	O	0	0
			6	3	3		
6	A	1	Total	C	O	0	0
			6	3	3		
6	A	1	Total	C	O	0	0
			6	3	3		
6	B	1	Total	C	O	0	0
			6	3	3		
6	B	1	Total	C	O	0	0
			6	3	3		

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

- Molecule 7 is ACETATE ION (three-letter code: ACT) (formula: $\text{C}_2\text{H}_3\text{O}_2$).



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

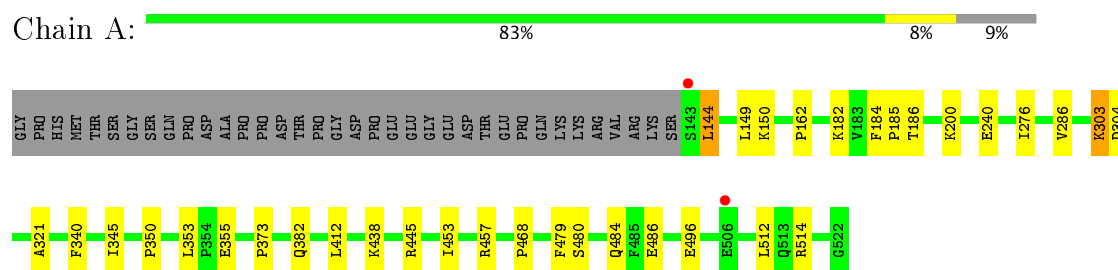
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	633	Total	O	0	0
			633	633		
8	B	553	Total	O	0	0
			553	553		
8	E	4	Total	O	0	0
			4	4		
8	F	6	Total	O	0	0
			6	6		

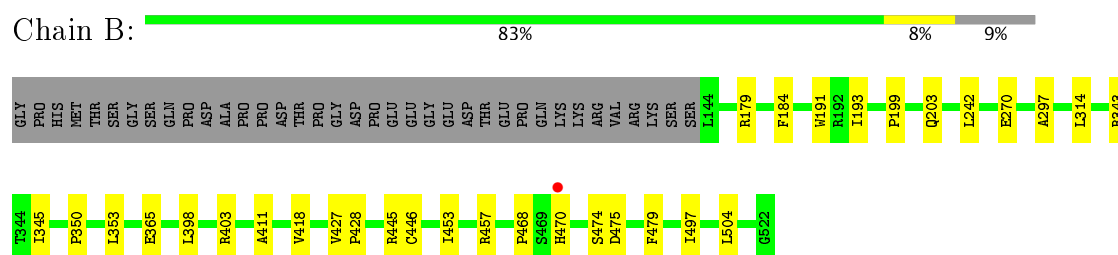
3 Residue-property plots [i](#)

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: BIFUNCTIONAL POLYNUCLEOTIDE PHOSPHATASE/KINASE



- Molecule 1: BIFUNCTIONAL POLYNUCLEOTIDE PHOSPHATASE/KINASE



- Molecule 2: 5'-D(*GP*TP*CP*AP*CP)-3'



- Molecule 2: 5'-D(*GP*TP*CP*AP*CP)-3'



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	44.82Å 75.24Å 135.20Å 90.00° 96.30° 90.00°	Depositor
Resolution (Å)	38.49 – 2.00 38.49 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.8 (38.49-2.00) 99.8 (38.49-2.00)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.56 (at 2.00Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, R_{free}	0.152 , 0.201 0.149 , 0.197	Depositor DCC
R_{free} test set	3069 reflections (5.06%)	DCC
Wilson B-factor (Å ²)	15.3	Xtriage
Anisotropy	0.046	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 54.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7426	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.78% 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, MG, EPE, ADP, ACT

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	0.39	0/3084	0.53	0/4185
1	B	0.39	0/3066	0.50	0/4159
2	E	0.55	0/67	0.98	0/101
2	F	0.57	0/61	1.13	0/92
All	All	0.39	0/6278	0.53	0/8537

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	2991	0	2997	24	0
1	B	2979	0	2965	26	0
2	E	61	0	34	1	0
2	F	55	0	32	6	0
3	A	27	0	12	0	0
3	B	27	0	12	0	0
4	A	15	0	17	2	0
4	B	15	0	17	1	0
5	A	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	B	2	0	0	0	0
6	A	24	0	32	1	0
6	B	24	0	32	6	0
7	B	8	0	6	0	0
8	A	633	0	0	14	1
8	B	553	0	0	9	1
8	E	4	0	0	0	0
8	F	6	0	0	0	0
All	All	7426	0	6156	58	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 5.

The worst 5 of 58 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:B:418:VAL:HB	8:B:2417:HOH:O	1.69	0.91
8:B:2034:HOH:O	2:F:2:DC:OP1	1.94	0.84
1:A:355:GLU:HG2	8:A:2393:HOH:O	1.85	0.77
1:A:457[B]:ARG:NH1	8:A:2531:HOH:O	2.23	0.71
1:B:191:TRP:O	6:B:1529:GOL:H2	1.96	0.65

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)
8:A:2470:HOH:O	8:B:2523:HOH:O[1_455]	2.05	0.15

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	383/416 (92%)	377 (98%)	5 (1%)	1 (0%)	44	40
1	B	381/416 (92%)	376 (99%)	5 (1%)	0	100	100
All	All	764/832 (92%)	753 (99%)	10 (1%)	1 (0%)	55	52

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	144	LEU

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	321/349 (92%)	317 (99%)	4 (1%)	75	80
1	B	320/349 (92%)	320 (100%)	0	100	100
All	All	641/698 (92%)	637 (99%)	4 (1%)	89	92

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	240	GLU
1	A	303	LYS
1	A	412	LEU
1	A	512	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA ⓘ

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, 4 are monoatomic - leaving 14 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	ADP	A	1523	5	25,29,29	1.08	2 (8%)	24,45,45	1.80	3 (12%)
4	EPE	A	1524	-	15,15,15	0.92	1 (6%)	18,20,20	1.90	6 (33%)
6	GOL	A	1527	-	5,5,5	0.33	0	5,5,5	0.28	0
6	GOL	A	1528	-	5,5,5	0.40	0	5,5,5	0.58	0
6	GOL	A	1529	-	5,5,5	0.32	0	5,5,5	0.32	0
6	GOL	A	1530	-	5,5,5	0.38	0	5,5,5	0.32	0
3	ADP	B	1523	5	25,29,29	1.14	3 (12%)	24,45,45	1.64	3 (12%)
4	EPE	B	1524	-	15,15,15	0.94	1 (6%)	18,20,20	1.96	6 (33%)
6	GOL	B	1527	-	5,5,5	0.24	0	5,5,5	0.77	0
6	GOL	B	1528	-	5,5,5	0.44	0	5,5,5	0.27	0
6	GOL	B	1529	-	5,5,5	0.16	0	5,5,5	0.72	0
6	GOL	B	1530	-	5,5,5	0.38	0	5,5,5	0.19	0
7	ACT	B	1531	-	1,3,3	0.87	0	0,3,3	0.00	-
7	ACT	B	1532	-	1,3,3	0.99	0	0,3,3	0.00	-

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
3	ADP	A	1523	5	-	0/12/32/32	0/3/3/3
4	EPE	A	1524	-	-	0/9/19/19	0/1/1/1
6	GOL	A	1527	-	-	0/4/4/4	0/0/0/0
6	GOL	A	1528	-	-	0/4/4/4	0/0/0/0
6	GOL	A	1529	-	-	0/4/4/4	0/0/0/0
6	GOL	A	1530	-	-	0/4/4/4	0/0/0/0
3	ADP	B	1523	5	-	0/12/32/32	0/3/3/3
4	EPE	B	1524	-	-	0/9/19/19	0/1/1/1
6	GOL	B	1527	-	-	0/4/4/4	0/0/0/0
6	GOL	B	1528	-	-	0/4/4/4	0/0/0/0
6	GOL	B	1529	-	-	0/4/4/4	0/0/0/0
6	GOL	B	1530	-	-	0/4/4/4	0/0/0/0
7	ACT	B	1531	-	-	0/0/0/0	0/0/0/0
7	ACT	B	1532	-	-	0/0/0/0	0/0/0/0

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	1523	ADP	PB-O3A	2.00	1.63	1.60
3	B	1523	ADP	O4'-C1'	2.13	1.44	1.41
3	A	1523	ADP	PB-O3A	2.48	1.64	1.60
3	A	1523	ADP	C5-C4	3.12	1.47	1.40
3	B	1523	ADP	C5-C4	3.15	1.47	1.40

The worst 5 of 18 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	1523	ADP	N3-C2-N1	-6.52	123.18	128.86
3	B	1523	ADP	N3-C2-N1	-6.04	123.60	128.86
3	A	1523	ADP	C4-C5-N7	-2.66	106.84	109.41
3	B	1523	ADP	C4-C5-N7	-2.40	107.09	109.41
4	A	1524	EPE	O1S-S-C10	2.10	108.59	106.79

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	1524	EPE	2	0
6	A	1528	GOL	1	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	1524	EPE	1	0
6	B	1529	GOL	5	0
6	B	1530	GOL	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 [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	380/416 (91%)	-0.52	2 (0%) 90 90	5, 13, 29, 49	0
1	B	379/416 (91%)	-0.45	1 (0%) 93 93	7, 16, 31, 61	0
2	E	4/5 (80%)	0.09	0 100 100	26, 33, 36, 43	4 (100%)
2	F	3/5 (60%)	0.18	0 100 100	28, 28, 29, 32	3 (100%)
All	All	766/842 (90%)	-0.48	3 (0%) 92 92	5, 14, 31, 61	7 (0%)

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	470	HIS	3.7
1	A	143	SER	2.5
1	A	506	GLU	2.2

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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(\AA^2)	Q<0.9
6	GOL	B	1530	6/6	0.89	0.25	20.71	23,31,32,40	0
6	GOL	B	1528	6/6	0.94	0.15	7.78	18,24,27,39	0
6	GOL	A	1529	6/6	0.95	0.17	5.19	14,17,19,25	6
6	GOL	B	1529	6/6	0.78	0.16	4.64	19,25,30,33	0
6	GOL	A	1527	6/6	0.89	0.16	4.43	28,37,40,45	0
6	GOL	B	1527	6/6	0.93	0.13	3.91	10,14,20,28	0
6	GOL	A	1528	6/6	0.96	0.11	3.50	6,13,17,17	6
5	MG	B	1525	1/1	0.99	0.16	2.29	4,4,4,4	0
6	GOL	A	1530	6/6	0.96	0.13	2.20	15,19,21,28	0
5	MG	A	1525	1/1	1.00	0.15	2.07	3,3,3,3	0
4	EPE	A	1524	15/15	0.96	0.11	1.82	14,25,33,33	0
7	ACT	B	1532	4/4	0.94	0.12	1.45	24,36,38,47	0
4	EPE	B	1524	15/15	0.95	0.17	0.82	26,35,50,54	0
7	ACT	B	1531	4/4	0.90	0.12	0.49	22,26,33,35	0
3	ADP	A	1523	27/27	0.99	0.08	-0.49	6,9,17,22	0
3	ADP	B	1523	27/27	0.98	0.07	-0.77	8,12,14,15	0
5	MG	B	1526	1/1	0.98	0.09	-	17,17,17,17	0
5	MG	A	1526	1/1	1.00	0.10	-	9,9,9,9	0

6.5 Other polymers ⓘ

There are no such residues in this entry.