



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 07:04 AM GMT

PDB ID : 2ZE7  
Title : Crystal Structure of adenosine phosphate-isopentenyltransferase complexed with zinc ion and substrate analog, DMASPP  
Authors : Sakakibara, H.  
Deposited on : 2007-12-06  
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](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) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
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) : trunk26865

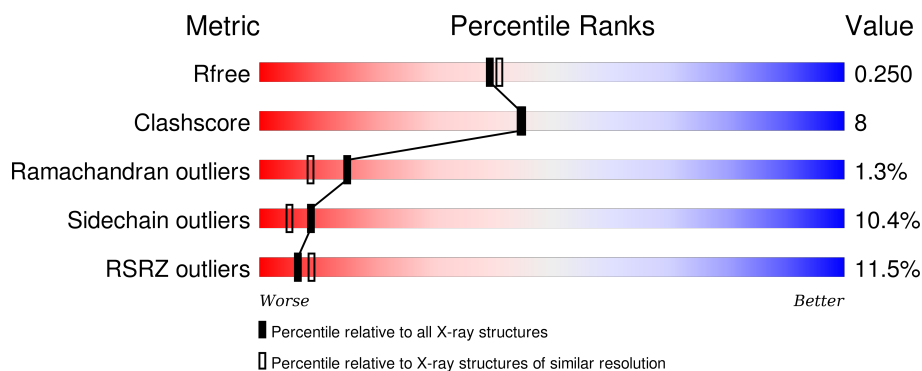
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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))
$R_{free}$	91344	3939 (2.10-2.10)
Clashscore	102246	4460 (2.10-2.10)
Ramachandran outliers	100387	4413 (2.10-2.10)
Sidechain outliers	100360	4414 (2.10-2.10)
RSRZ outliers	91569	3948 (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 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.

Mol	Chain	Length	Quality of chain
1	A	253	<div> <div>10%</div> <div>62%</div> <div>21%</div> <div>5%</div> <div>11%</div> </div>

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 1887 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 Isopentenyl transferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	226	Total	C	N	O	S	0	0	0
			1815	1146	327	333	9			

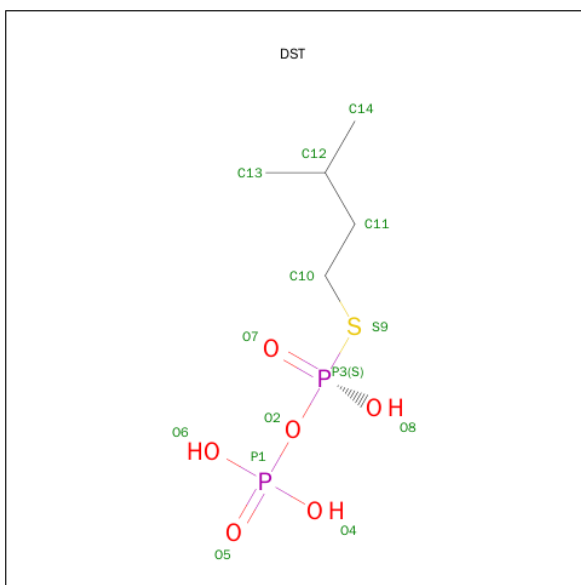
There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	244	GLY	-	EXPRESSION TAG	UNP P58758
A	245	SER	-	EXPRESSION TAG	UNP P58758
A	246	ARG	-	EXPRESSION TAG	UNP P58758
A	247	SER	-	EXPRESSION TAG	UNP P58758
A	248	HIS	-	EXPRESSION TAG	UNP P58758
A	249	HIS	-	EXPRESSION TAG	UNP P58758
A	250	HIS	-	EXPRESSION TAG	UNP P58758
A	251	HIS	-	EXPRESSION TAG	UNP P58758
A	252	HIS	-	EXPRESSION TAG	UNP P58758
A	253	HIS	-	EXPRESSION TAG	UNP P58758

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

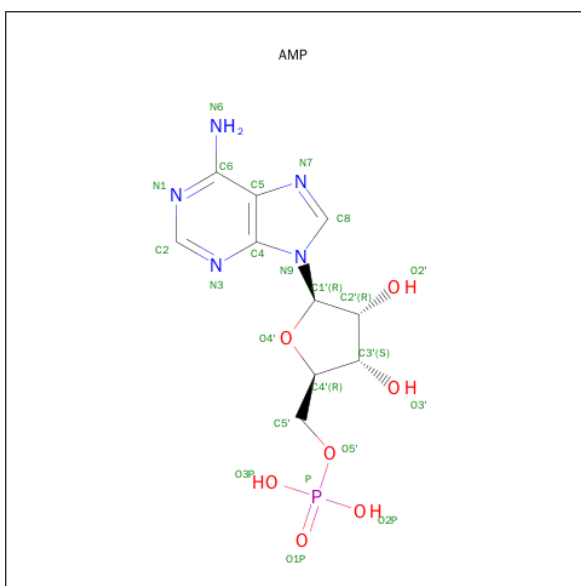
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Zn	0	0
			2	2		

- Molecule 3 is DIMETHYLALLYL S-THIOLODIPHOSPHATE (three-letter code: DST) (formula: C<sub>5</sub>H<sub>14</sub>O<sub>6</sub>P<sub>2</sub>S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	A	1	Total	C	O	P	S	0	0
			14	5	6	2	1		

- Molecule 4 is ADENOSINE MONOPHOSPHATE (three-letter code: AMP) (formula:  $C_{10}H_{14}N_5O_7P$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	0
			23	10	5	7	1		

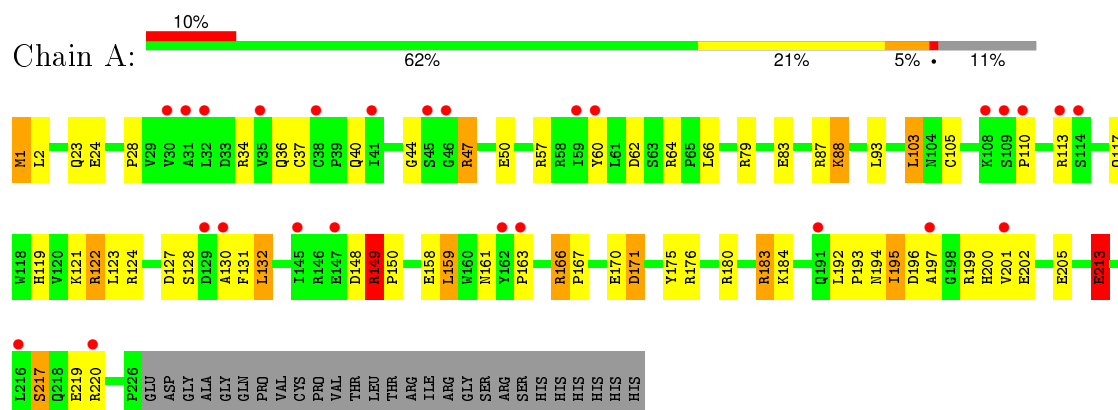
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	33	Total 33	O 33	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 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.

- Molecule 1: Isopentenyl transferase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 4 <sub>2</sub> 2 <sub>1</sub> 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	97.93Å 97.93Å 65.33Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	69.17 – 2.10 30.98 – 2.10	Depositor EDS
% Data completeness (in resolution range)	96.9 (69.17-2.10) 96.9 (30.98-2.10)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	6.69 (at 2.10Å)	Xtriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.192 , 0.254 0.194 , 0.250	Depositor DCC
$R_{free}$ test set	942 reflections (5.37%)	DCC
Wilson B-factor (Å <sup>2</sup> )	40.6	Xtriage
Anisotropy	0.549	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 65.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtriage
Outliers	0 of 18487 reflections	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	1887	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	54.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.05% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

## 5 Model quality ⓘ

### 5.1 Standard geometry ⓘ

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

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	1.33	10/1856 (0.5%)	1.39	20/2514 (0.8%)

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	213	GLU	CB-CG	15.91	1.82	1.52
1	A	213	GLU	CG-CD	8.34	1.64	1.51
1	A	122	ARG	CZ-NH1	7.98	1.43	1.33
1	A	24	GLU	CD-OE1	7.53	1.33	1.25
1	A	105	CYS	CB-SG	-6.20	1.71	1.82
1	A	50	GLU	CD-OE1	5.61	1.31	1.25
1	A	88	LYS	CD-CE	5.57	1.65	1.51
1	A	37	CYS	CB-SG	5.25	1.91	1.82
1	A	83	GLU	CD-OE2	5.25	1.31	1.25
1	A	217	SER	CB-OG	-5.24	1.35	1.42

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	47	ARG	NE-CZ-NH1	23.31	131.96	120.30
1	A	47	ARG	NE-CZ-NH2	-22.54	109.03	120.30
1	A	127	ASP	CB-CG-OD2	-9.27	109.96	118.30
1	A	88	LYS	CD-CE-NZ	8.35	130.91	111.70
1	A	127	ASP	CB-CG-OD1	7.83	125.35	118.30
1	A	47	ARG	CD-NE-CZ	7.68	134.35	123.60
1	A	213	GLU	OE1-CD-OE2	-7.28	114.56	123.30
1	A	66	LEU	CA-CB-CG	7.05	131.52	115.30
1	A	149	ARG	NE-CZ-NH2	-6.74	116.93	120.30
1	A	159	LEU	CA-CB-CG	6.68	130.66	115.30
1	A	166	ARG	NE-CZ-NH2	-6.53	117.04	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	183	ARG	NE-CZ-NH1	6.24	123.42	120.30
1	A	103	LEU	CA-CB-CG	-6.13	101.20	115.30
1	A	47	ARG	CB-CG-CD	6.00	127.20	111.60
1	A	122	ARG	NE-CZ-NH1	-5.58	117.51	120.30
1	A	66	LEU	CB-CG-CD1	-5.44	101.74	111.00
1	A	171	ASP	CB-CG-OD1	-5.40	113.44	118.30
1	A	23	GLN	CA-CB-CG	5.29	125.04	113.40
1	A	1	MET	CG-SD-CE	5.20	108.52	100.20
1	A	132	LEU	CA-CB-CG	5.13	127.10	115.30

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	1815	0	1798	27	0
2	A	2	0	0	0	0
3	A	14	0	10	1	0
4	A	23	0	12	5	0
5	A	33	0	0	1	0
All	All	1887	0	1820	29	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 8.

All (29) 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:213:GLU:CG	1:A:213:GLU:CB	1.82	1.56
1:A:47:ARG:HG2	1:A:60:TYR:OH	1.87	0.75
1:A:34:ARG:HH21	4:A:401:AMP:H5'1	1.54	0.71
1:A:34:ARG:NH2	4:A:401:AMP:H5'1	2.16	0.60
1:A:149:ARG:HG2	1:A:150:PRO:HD2	1.84	0.58
1:A:166:ARG:HB2	1:A:167:PRO:HD3	1.86	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:34:ARG:HH21	4:A:401:AMP:C5'	2.17	0.56
1:A:2:LEU:HD12	1:A:117:GLN:HB2	1.91	0.52
1:A:110:PRO:O	1:A:113:ARG:HG2	2.10	0.51
1:A:87:ARG:HD3	1:A:93:LEU:HD21	1.93	0.51
1:A:170:GLU:O	1:A:176:ARG:HG3	2.11	0.51
1:A:28:PRO:HD2	1:A:93:LEU:HD23	1.93	0.50
3:A:400:DST:H112	4:A:401:AMP:C6	2.49	0.48
4:A:401:AMP:C8	4:A:401:AMP:H5'2	2.48	0.47
1:A:130:ALA:O	1:A:131:PHE:C	2.53	0.46
1:A:2:LEU:HD11	1:A:119:HIS:ND1	2.33	0.44
1:A:161:ASN:O	1:A:163:PRO:HD3	2.18	0.44
1:A:195:ILE:HG12	1:A:199:ARG:HB3	2.00	0.44
1:A:217:SER:CB	1:A:220:ARG:NH2	2.81	0.44
1:A:195:ILE:CG2	1:A:200:HIS:HD2	2.32	0.43
1:A:62:ASP:OD1	1:A:64:ARG:HD2	2.18	0.43
1:A:192:LEU:N	1:A:193:PRO:CD	2.83	0.42
1:A:201:VAL:O	1:A:205:GLU:HG3	2.20	0.42
1:A:219:GLU:HA	1:A:219:GLU:OE2	2.21	0.41
1:A:36:GLN:O	1:A:47:ARG:HD2	2.21	0.41
1:A:79:ARG:NH1	1:A:79:ARG:HG2	2.36	0.41
1:A:124:ARG:HA	1:A:124:ARG:HD2	1.95	0.41
1:A:44:GLY:HA3	1:A:175:TYR:OH	2.20	0.41
1:A:40:GLN:HB2	5:A:433:HOH:O	2.20	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	224/253 (88%)	215 (96%)	6 (3%)	3 (1%)	<b>15</b> <b>9</b>

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	196	ASP
1	A	197	ALA
1	A	195	ILE

### 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	192/215 (89%)	172 (90%)	20 (10%)	9 5

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	57	ARG
1	A	88	LYS
1	A	103	LEU
1	A	121	LYS
1	A	122	ARG
1	A	123	LEU
1	A	128	SER
1	A	132	LEU
1	A	148	ASP
1	A	149	ARG
1	A	158	GLU
1	A	159	LEU
1	A	171	ASP
1	A	180	ARG
1	A	183	ARG
1	A	184	LYS
1	A	194	ASN
1	A	202	GLU
1	A	213	GLU

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

Mol	Chain	Res	Type
1	A	4	HIS
1	A	200	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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 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	DST	A	400	2	8,13,13	1.25	1 (12%)	11,19,19	1.89	3 (27%)
4	AMP	A	401	-	20,25,25	1.70	4 (20%)	22,38,38	3.87	11 (50%)

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	DST	A	400	2	-	0/9/13/13	0/0/0/0
4	AMP	A	401	-	-	0/6/26/26	0/3/3/3

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	400	DST	C11-C12	-2.37	1.33	1.51
4	A	401	AMP	C2-N3	2.74	1.37	1.32
4	A	401	AMP	C4-N3	2.75	1.39	1.35
4	A	401	AMP	C5-C4	3.63	1.48	1.40
4	A	401	AMP	O4'-C1'	3.82	1.46	1.41

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	401	AMP	N3-C2-N1	-12.31	119.47	128.89
4	A	401	AMP	C5'-C4'-C3'	-6.85	88.04	115.21
4	A	401	AMP	C2'-C1'-N9	-5.07	106.55	114.29
4	A	401	AMP	O2P-P-O5'	-2.85	98.36	106.56
4	A	401	AMP	O2'-C2'-C3'	-2.76	102.84	111.83
4	A	401	AMP	O4'-C4'-C3'	-2.73	99.64	105.15
4	A	401	AMP	O3'-C3'-C4'	-2.46	103.66	111.05
3	A	400	DST	O4-P1-O2	-2.37	94.34	105.09
4	A	401	AMP	O3P-P-O1P	2.87	119.80	110.58
4	A	401	AMP	O3P-P-O5'	2.96	115.10	106.56
3	A	400	DST	O4-P1-O5	2.97	120.15	110.58
3	A	400	DST	O8-P3-O7	3.45	118.65	110.05
4	A	401	AMP	C2'-C3'-C4'	4.50	111.86	102.61
4	A	401	AMP	C2-N1-C6	4.91	127.53	118.77

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	400	DST	1	0
4	A	401	AMP	5	0

## 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 ⓘ

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	226/253 (89%)	0.71	26 (11%) 6 9	44, 52, 68, 80	0

All (26) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	145	ILE	4.8
1	A	130	ALA	4.1
1	A	197	ALA	3.8
1	A	110	PRO	3.6
1	A	113	ARG	3.3
1	A	108	LYS	3.2
1	A	45	SER	3.2
1	A	163	PRO	3.1
1	A	30	VAL	3.0
1	A	114	SER	2.8
1	A	46	GLY	2.7
1	A	32	LEU	2.7
1	A	129	ASP	2.7
1	A	41	ILE	2.7
1	A	162	TYR	2.7
1	A	147	GLU	2.6
1	A	191	GLN	2.5
1	A	109	SER	2.5
1	A	31	ALA	2.4
1	A	38	CYS	2.3
1	A	35	VAL	2.3
1	A	59	ILE	2.2
1	A	216	LEU	2.2
1	A	201	VAL	2.2
1	A	220	ARG	2.1
1	A	60	TYR	2.1

## 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, 95<sup>th</sup> 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( $\text{\AA}^2$ )	Q<0.9
3	DST	A	400	14/14	0.98	0.17	-0.07	53,61,67,71	0
4	AMP	A	401	23/23	0.96	0.18	-0.30	48,51,56,59	0
2	ZN	A	301	1/1	0.97	0.18	-0.36	70,70,70,70	0
2	ZN	A	302	1/1	0.99	0.12	-	66,66,66,66	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.