



# wwPDB X-ray Structure Validation Summary Report ⓘ

Sep 27, 2017 – 05:40 PM EDT

PDB ID : 1II0  
Title : CRYSTAL STRUCTURE OF THE ESCHERICHIA COLI ARSENITE-TRANSLOCATING ATPASE  
Authors : Zhou, T.; Radaev, S.; Rosen, B.P.; Gatti, D.L.  
Deposited on : unknown  
Resolution : 2.40 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](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 : 1.7.2 (RC1), CSD as538be (2017)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20030345  
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-20030345

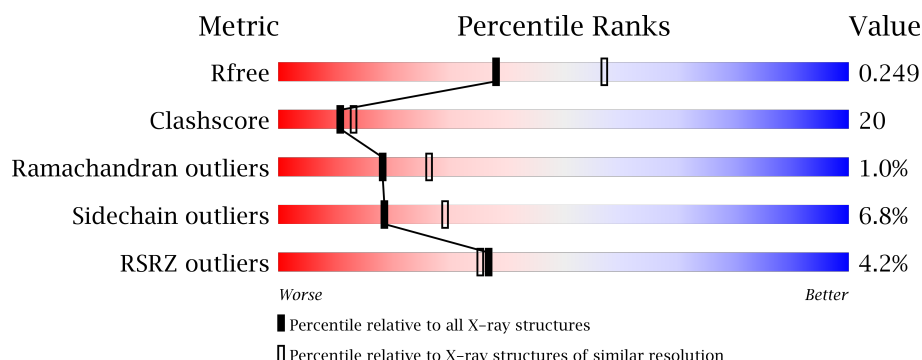
# 1 Overall quality at a glance

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))
$R_{free}$	100719	3166 (2.40-2.40)
Clashscore	112137	3674 (2.40-2.40)
Ramachandran outliers	110173	3616 (2.40-2.40)
Sidechain outliers	110143	3617 (2.40-2.40)
RSRZ outliers	101464	3195 (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.

Mol	Chain	Length	Quality of chain
1	A	589	
1	B	589	

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 criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	CL	B	1599	-	-	-	X
3	CL	B	4001	-	-	X	-
7	TAS	A	701	-	-	-	X
7	TAS	B	1701	-	-	-	X

## 2 Entry composition [i](#)

There are 8 unique types of molecules in this entry. The entry contains 8927 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 ARSENICAL PUMP-DRIVING ATPASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	550	Total	C	N	O	S	0	0	0
			4201	2642	743	801	15			
1	B	553	Total	C	N	O	S	0	0	0
			4224	2655	748	806	15			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	60	ASN	ILE	SEE REMARK 999	UNP P08690
A	584	HIS	-	EXPRESSION TAG	UNP P08690
A	585	HIS	-	EXPRESSION TAG	UNP P08690
A	586	HIS	-	EXPRESSION TAG	UNP P08690
A	587	HIS	-	EXPRESSION TAG	UNP P08690
A	588	HIS	-	EXPRESSION TAG	UNP P08690
A	589	HIS	-	EXPRESSION TAG	UNP P08690
B	1060	ASN	ILE	SEE REMARK 999	UNP P08690
B	1584	HIS	-	EXPRESSION TAG	UNP P08690
B	1585	HIS	-	EXPRESSION TAG	UNP P08690
B	1586	HIS	-	EXPRESSION TAG	UNP P08690
B	1587	HIS	-	EXPRESSION TAG	UNP P08690
B	1588	HIS	-	EXPRESSION TAG	UNP P08690
B	1589	HIS	-	EXPRESSION TAG	UNP P08690

- Molecule 2 is CADMIUM ION (three-letter code: CD) (formula: Cd).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	8	Total	Cd	0	0
			8	8		
2	A	9	Total	Cd	0	0
			9	9		

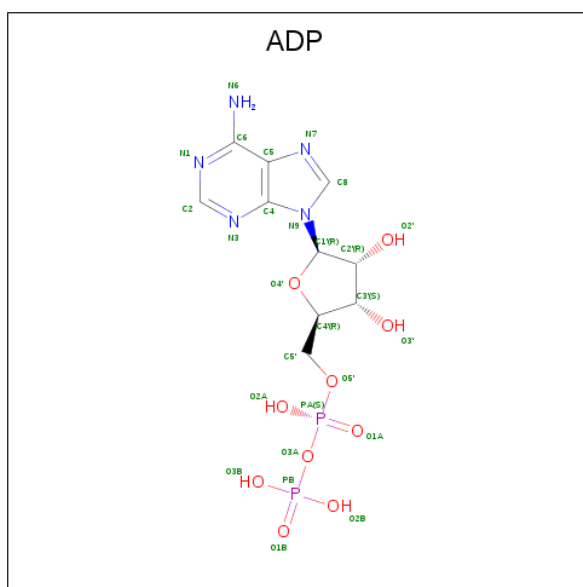
- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	4	Total Cl 4 4	0	0
3	A	3	Total Cl 3 3	0	0

- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

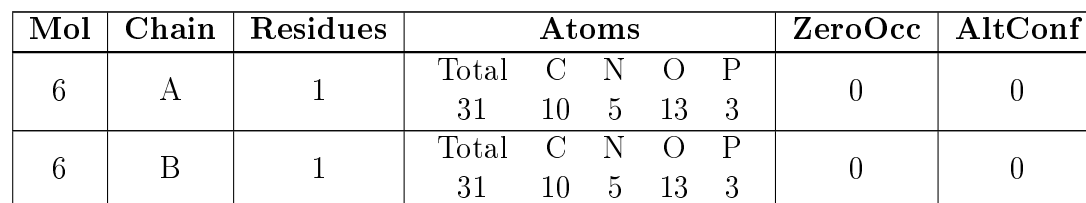
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	B	2	Total Mg 2 2	0	0
4	A	2	Total Mg 2 2	0	0

- Molecule 5 is ADENOSINE-5'-DIPHOSPHATE (three-letter code: ADP) (formula:  $C_{10}H_{15}N_5O_{10}P_2$ ).



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

- Molecule 6 is ADENOSINE-5'-TRIPHOSPHATE (three-letter code: ATP) (formula:  $C_{10}H_{16}N_5O_{13}P_3$ ).



- TAS
- 
- The diagram shows the chemical structure of Arsenic(III) trihydroxide (TAS). A central pink 'As' atom is bonded to three red 'OH' groups. The top-right 'OH' group is labeled 'O2' in green. The left 'HO' group is labeled 'O1' in green. The bottom-right 'OH' group is labeled 'O3' in green. A green 'AS' label is positioned to the right of the central 'As' atom. The entire structure is enclosed in a black rectangular box.

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	A	1	Total 4	As 1	O 3	0	0
7	B	1	Total 4	As 1	O 3	0	0

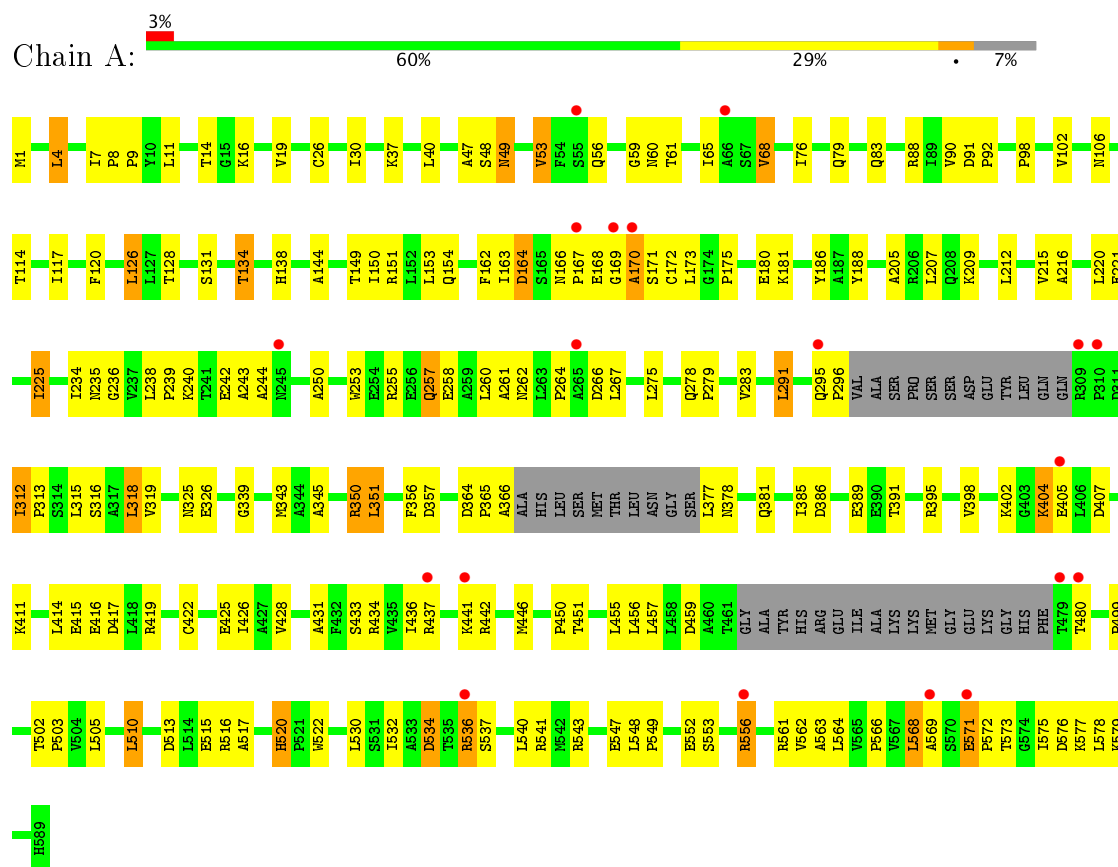
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	171	Total 171	O 171	0	0
8	B	179	Total 179	O 179	0	0

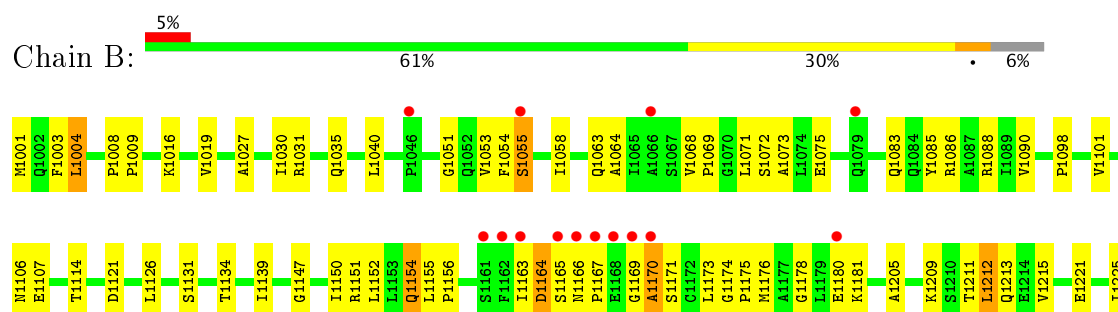
### 3 Residue-property plots

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

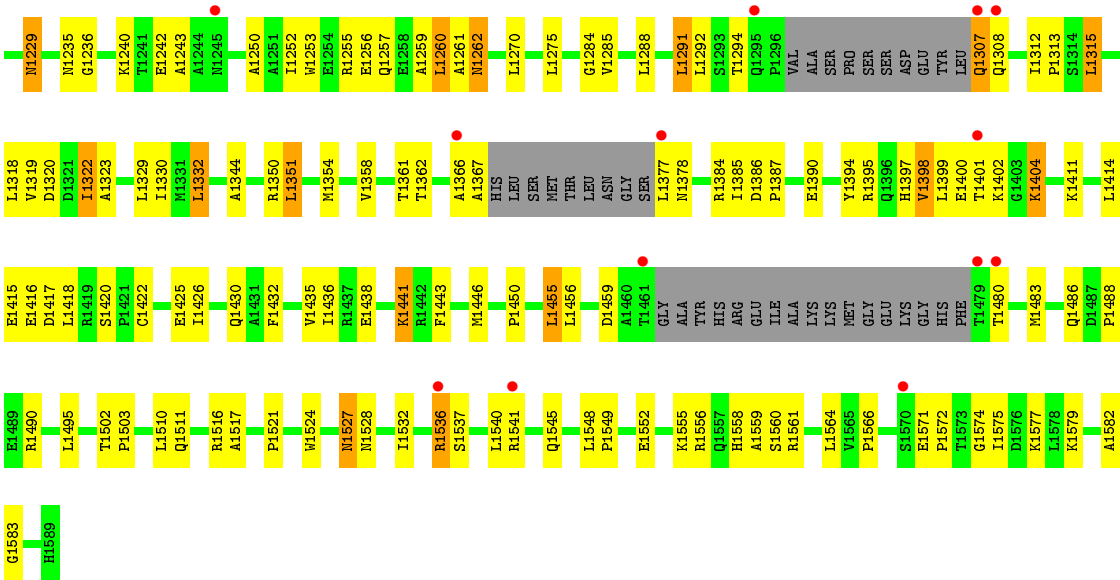
#### • Molecule 1: ARSENICAL PUMP-DRIVING ATPASE



#### • Molecule 1: ARSENICAL PUMP-DRIVING ATPASE







## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	76.73Å 222.19Å 74.13Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	28.61 – 2.40 30.43 – 2.40	Depositor EDS
% Data completeness (in resolution range)	90.0 (28.61-2.40) 89.7 (30.43-2.40)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.61 (at 2.39Å)	Xtriage
Refinement program	CNS	Depositor
R, $R_{free}$	0.210 , 0.252 0.208 , 0.249	Depositor DCC
$R_{free}$ test set	4564 reflections (11.18%)	DCC
Wilson B-factor (Å <sup>2</sup> )	34.3	Xtriage
Anisotropy	0.038	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 44.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.020 for l,-k,h	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	8927	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.47% 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, 0.333 respectively for untwinned datasets, and 0.375, 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: MG, ADP, CL, TAS, CD, ATP

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	0.33	0/4273	0.61	0/5810
1	B	0.32	0/4296	0.61	0/5841
All	All	0.33	0/8569	0.61	0/11651

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

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	4201	0	4261	166	0
1	B	4224	0	4279	179	0
2	A	9	0	0	0	0
2	B	8	0	0	0	0
3	A	3	0	0	0	0
3	B	4	0	0	3	0
4	A	2	0	0	0	0
4	B	2	0	0	0	0
5	A	27	0	12	2	0
5	B	27	0	12	2	0
6	A	31	0	12	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	B	31	0	12	1	0
7	A	4	0	0	1	0
7	B	4	0	0	0	0
8	A	171	0	0	10	0
8	B	179	0	0	13	0
All	All	8927	0	8588	348	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 20.

The worst 5 of 348 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:1436:ILE:HG12	1:B:1446:MET:HE2	1.47	0.96
1:A:385:ILE:HD11	1:A:428:VAL:HG13	1.45	0.95
1:B:1209:LYS:HG2	1:B:1213:GLN:HE21	1.31	0.94
1:A:381:GLN:NE2	1:A:442:ARG:HH22	1.67	0.93
1:B:1170:ALA:HB3	1:B:1402:LYS:HZ3	1.34	0.92

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	542/589 (92%)	509 (94%)	27 (5%)	6 (1%)	17	23
1	B	545/589 (92%)	514 (94%)	26 (5%)	5 (1%)	20	29
All	All	1087/1178 (92%)	1023 (94%)	53 (5%)	11 (1%)	18	26

5 of 11 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	164	ASP
1	A	244	ALA
1	A	48	SER
1	A	170	ALA
1	B	1170	ALA

### 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	456/487 (94%)	423 (93%)	33 (7%)	17	26
1	B	458/487 (94%)	429 (94%)	29 (6%)	21	33
All	All	914/974 (94%)	852 (93%)	62 (7%)	18	29

5 of 62 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	553	SER
1	B	1040	LEU
1	B	1510	LEU
1	A	568	LEU
1	B	1126	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 39 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	1035	GLN
1	B	1108	GLN
1	B	1509	ASN
1	B	1052	GLN
1	B	1079	GLN

### 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 34 ligands modelled in this entry, 28 are monoatomic - leaving 6 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	$\# Z  > 2$
5	ADP	A	590	4	25,29,29	1.43	3 (12%)	24,45,45	5.73	12 (50%)
6	ATP	A	591	4	27,33,33	0.76	0	25,52,52	2.71	4 (16%)
7	TAS	A	701	-	0,3,3	0.00	-	0,3,3	0.00	-
5	ADP	B	1590	4	25,29,29	1.36	3 (12%)	24,45,45	4.66	13 (54%)
6	ATP	B	1591	4	27,33,33	0.82	1 (3%)	25,52,52	2.74	6 (24%)
7	TAS	B	1701	-	0,3,3	0.00	-	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
5	ADP	A	590	4	-	0/12/32/32	0/3/3/3
6	ATP	A	591	4	-	0/18/38/38	0/3/3/3
7	TAS	A	701	-	-	0/0/0/0	0/0/0/0
5	ADP	B	1590	4	-	0/12/32/32	0/3/3/3
6	ATP	B	1591	4	-	0/18/38/38	0/3/3/3
7	TAS	B	1701	-	-	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)
5	A	590	ADP	C8-N7	-3.76	1.27	1.34
5	A	590	ADP	PB-O3A	-3.59	1.54	1.60
5	B	1590	ADP	C8-N7	-3.57	1.28	1.34
5	B	1590	ADP	PB-O3A	-2.90	1.55	1.60
5	B	1590	ADP	C2'-C3'	2.08	1.58	1.53

The worst 5 of 35 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	591	ATP	N3-C2-N1	-11.08	119.21	128.86
5	A	590	ADP	N3-C2-N1	-10.64	119.59	128.86
5	B	1590	ADP	N3-C2-N1	-10.59	119.63	128.86
6	B	1591	ATP	N3-C2-N1	-10.21	119.96	128.86
5	A	590	ADP	O4'-C4'-C3'	-7.69	89.88	105.17

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	590	ADP	2	0
7	A	701	TAS	1	0
5	B	1590	ADP	2	0
6	B	1591	ATP	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, 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	550/589 (93%)	0.03	19 (3%)	44 43	20, 36, 66, 81	0
1	B	553/589 (93%)	0.13	27 (4%)	30 29	21, 38, 67, 95	0
All	All	1103/1178 (93%)	0.08	46 (4%)	37 35	20, 38, 66, 95	0

The worst 5 of 46 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	1169	GLY	11.8
1	A	169	GLY	8.2
1	B	1170	ALA	6.7
1	B	1307	GLN	5.4
1	B	1308	GLN	5.4

### 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
7	TAS	A	701	4/4	0.48	0.61	36.26	79,79,79,80	4
3	CL	B	1599	1/1	0.58	0.61	28.87	63,63,63,63	1
7	TAS	B	1701	4/4	0.82	0.43	15.71	63,63,63,65	4
5	ADP	B	1590	27/27	0.97	0.15	-0.03	32,37,39,39	0
5	ADP	A	590	27/27	0.97	0.14	-0.52	26,36,38,39	0
2	CD	A	596	1/1	1.00	0.09	-0.89	29,29,29,29	0
2	CD	B	1596	1/1	1.00	0.09	-0.98	30,30,30,30	0
6	ATP	B	1591	31/31	0.97	0.12	-1.05	27,35,38,39	0
2	CD	A	595	1/1	1.00	0.09	-1.14	27,27,27,27	0
2	CD	B	1595	1/1	1.00	0.09	-1.15	24,24,24,24	0
6	ATP	A	591	31/31	0.98	0.11	-1.18	29,35,39,39	0
3	CL	A	598	1/1	0.99	0.08	-1.30	30,30,30,30	0
3	CL	B	1597	1/1	0.98	0.07	-1.31	31,31,31,31	0
3	CL	B	1598	1/1	1.00	0.06	-1.65	24,24,24,24	0
3	CL	A	597	1/1	0.99	0.04	-2.02	26,26,26,26	0
3	CL	A	4000	1/1	1.00	0.05	-9.49	22,22,22,22	0
4	MG	B	1592	1/1	0.98	0.07	-	16,16,16,16	0
2	CD	A	603	1/1	0.97	0.04	-	91,91,91,91	0
2	CD	B	1601	1/1	1.00	0.09	-	26,26,26,26	0
2	CD	A	604	1/1	0.99	0.06	-	42,42,42,42	0
2	CD	A	602	1/1	1.00	0.09	-	31,31,31,31	0
2	CD	B	1602	1/1	1.00	0.09	-	29,29,29,29	0
2	CD	B	1594	1/1	0.99	0.08	-	28,28,28,28	0
2	CD	B	1608	1/1	0.60	0.15	-	90,90,90,90	1
2	CD	B	1603	1/1	0.95	0.06	-	75,75,75,75	0
2	CD	A	601	1/1	1.00	0.08	-	22,22,22,22	0
2	CD	A	605	1/1	0.98	0.06	-	45,45,45,45	1
3	CL	B	4001	1/1	0.82	0.39	-	50,50,50,50	1
2	CD	B	1607	1/1	0.99	0.05	-	33,33,33,33	1
4	MG	A	593	1/1	0.98	0.09	-	29,29,29,29	0
4	MG	B	1593	1/1	0.98	0.08	-	23,23,23,23	0
2	CD	A	600	1/1	1.00	0.08	-	22,22,22,22	0
2	CD	A	594	1/1	0.99	0.08	-	32,32,32,32	0
4	MG	A	592	1/1	0.97	0.15	-	17,17,17,17	0

## 6.5 Other polymers ⓘ

There are no such residues in this entry.