



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 12:42 PM GMT

PDB ID : 3RTD
Title : Crystal structure of tm0922, a fusion of a domain of unknown function and ADP/ATP-dependent NAD(P)H-hydrate dehydratase from *Thermotoga maritima* soaked with NADH and ADP.
Authors : Shumilin, I.A.; Cymborowski, M.; Lesley, S.A.; Minor, W.
Deposited on : 2011-05-03
Resolution : 2.30 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
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 (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

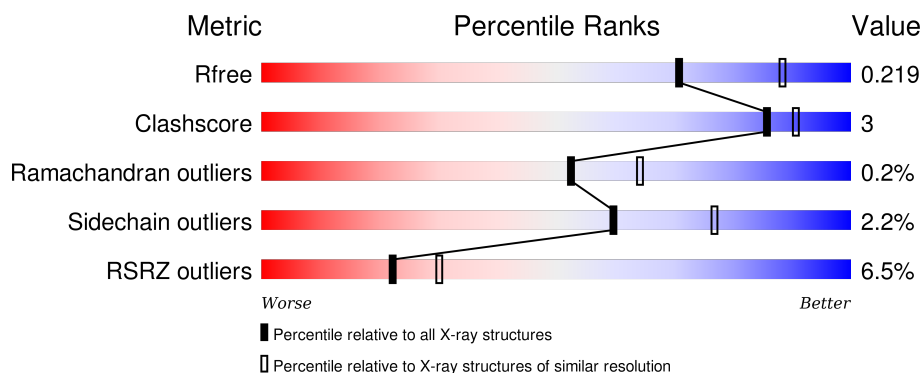
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	3852 (2.30-2.30)
Clashscore	102246	4452 (2.30-2.30)
Ramachandran outliers	100387	4410 (2.30-2.30)
Sidechain outliers	100360	4409 (2.30-2.30)
RSRZ outliers	91569	3857 (2.30-2.30)

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	502	<div> <div>6%</div> <div>88%</div> <div>9%</div> <div>.</div> </div>
2	B	7	<div> <div>14%</div> <div>100%</div> </div>

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 3958 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 Putative uncharacterized protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	489	Total	C	N	O	S	0	0	0
			3721	2376	628	706	11			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-11	MET	-	EXPRESSION TAG	UNP Q9X024
A	-10	GLY	-	EXPRESSION TAG	UNP Q9X024
A	-9	SER	-	EXPRESSION TAG	UNP Q9X024
A	-8	ASP	-	EXPRESSION TAG	UNP Q9X024
A	-7	LYS	-	EXPRESSION TAG	UNP Q9X024
A	-6	ILE	-	EXPRESSION TAG	UNP Q9X024
A	-5	HIS	-	EXPRESSION TAG	UNP Q9X024
A	-4	HIS	-	EXPRESSION TAG	UNP Q9X024
A	-3	HIS	-	EXPRESSION TAG	UNP Q9X024
A	-2	HIS	-	EXPRESSION TAG	UNP Q9X024
A	-1	HIS	-	EXPRESSION TAG	UNP Q9X024
A	0	HIS	-	EXPRESSION TAG	UNP Q9X024

- Molecule 2 is a protein called Unknown peptide, probably from expression host.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	7	Total	C	N	O	0	0	0
			57	40	8	9			

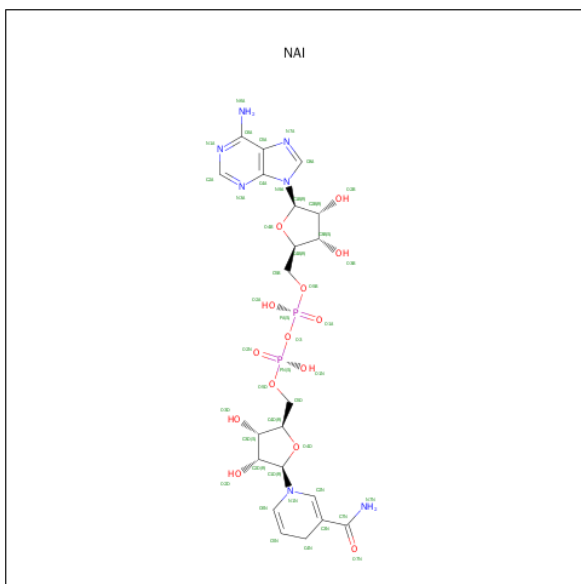
- Molecule 3 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	K	0	0
			1	1		

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

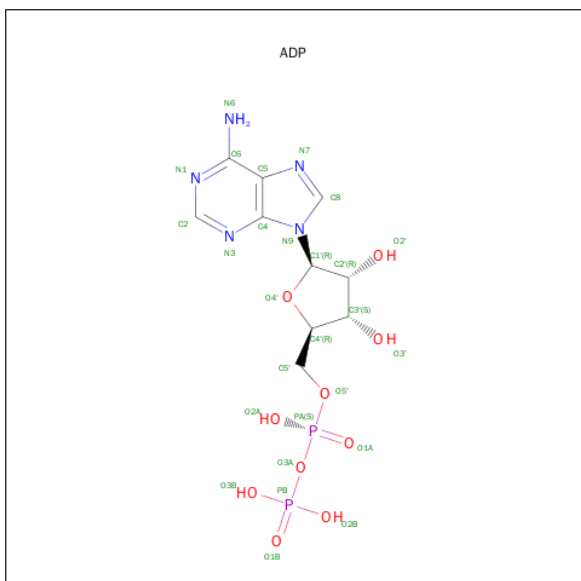
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total Mg 1 1	0	0

- Molecule 5 is 1,4-DIHYDRONICOTINAMIDE ADENINE DINUCLEOTIDE (three-letter code: NAI) (formula: $C_{21}H_{29}N_7O_{14}P_2$).



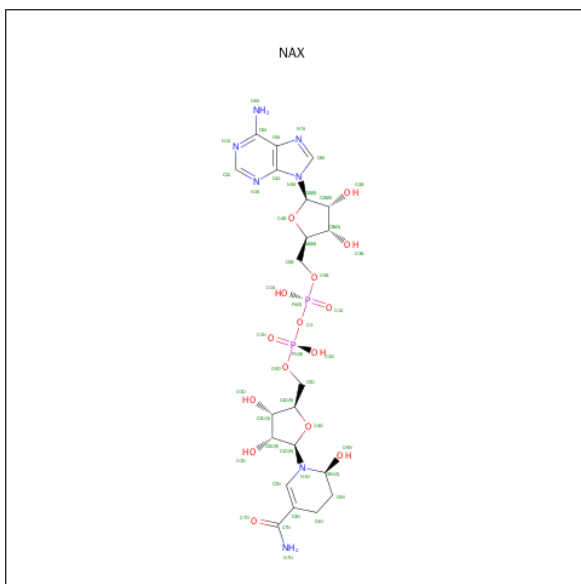
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total	C	N	O	P	0	0
			36	15	6	13	2		

- Molecule 6 is ADENOSINE-5'-DIPHOSPHATE (three-letter code: ADP) (formula: $C_{10}H_{15}N_5O_{10}P_2$).



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

- Molecule 7 is BETA-6-HYDROXY-1,4,5,6-TETRHYDRONICOTINAMIDE ADENINE DINUCLEOTIDE (three-letter code: NAX) (formula: $C_{21}H_{31}N_7O_{15}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
7	A	1	Total	C	N	O	P	0	0
			45	21	7	15	2		

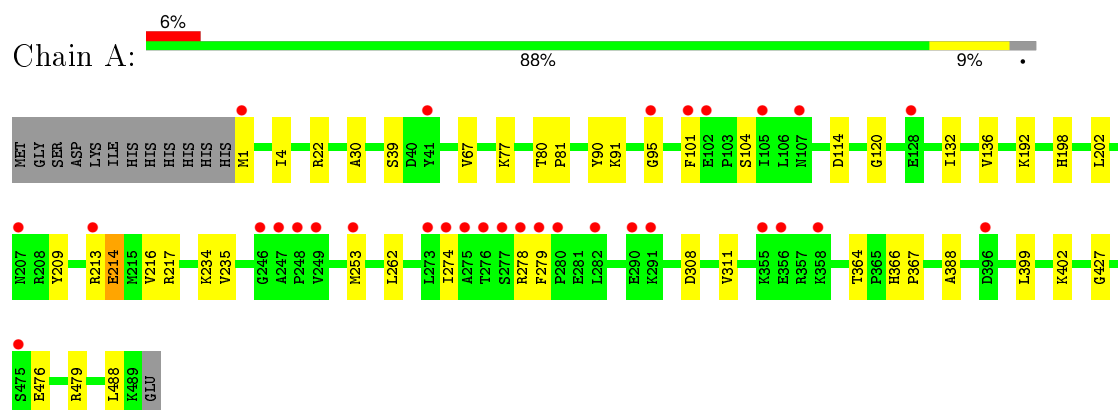
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	70	Total	O	0	0
			70	70		

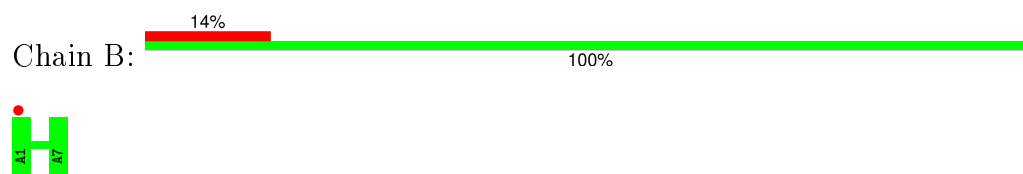
3 Residue-property plots [i](#)

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: Putative uncharacterized protein



- Molecule 2: Unknown peptide, probably from expression host



4 Data and refinement statistics

Property	Value	Source
Space group	I 4 2 2	Depositor
Cell constants a, b, c, α , β , γ	121.81Å 121.81Å 155.22Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.30 43.07 – 2.30	Depositor EDS
% Data completeness (in resolution range)	98.7 (50.00-2.30) 98.7 (43.07-2.30)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.54 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.164 , 0.219 0.171 , 0.219	Depositor DCC
R_{free} test set	1322 reflections (5.37%)	DCC
Wilson B-factor (Å ²)	39.7	Xtriage
Anisotropy	0.081	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.40 , 46.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Outliers	1 of 25944 reflections (0.004%)	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3958	wwPDB-VP
Average B, all atoms (Å ²)	44.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.16% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: MG, NAI, K, ADP, NAX

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	0.97	1/3779 (0.0%)	0.85	1/5112 (0.0%)
2	B	1.12	0/59	0.80	0/80
All	All	0.98	1/3838 (0.0%)	0.85	1/5192 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	214	GLU	CG-CD	5.79	1.60	1.51

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	22	ARG	NE-CZ-NH2	-5.02	117.79	120.30

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	3721	0	3839	22	0
2	B	57	0	53	0	0
3	A	1	0	0	0	0
4	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	36	0	20	1	0
6	A	27	0	12	2	0
7	A	45	0	29	1	0
8	A	70	0	0	0	0
All	All	3958	0	3953	22	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 3.

All (22) 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:216:VAL:HG12	1:A:488:LEU:HD21	1.50	0.90
1:A:476:GLU:OE2	1:A:479:ARG:NH2	2.20	0.71
1:A:4:ILE:HD12	1:A:202:LEU:HB3	1.84	0.59
1:A:402:LYS:HD2	6:A:494:ADP:H3'	1.85	0.57
1:A:364:THR:O	1:A:402:LYS:HE2	2.03	0.57
1:A:235:VAL:HG22	1:A:311:VAL:CG1	2.35	0.57
1:A:101:PHE:CE2	1:A:132:ILE:HG23	2.40	0.57
1:A:214:GLU:HG3	1:A:217:ARG:HH12	1.74	0.53
1:A:367:PRO:HD3	1:A:402:LYS:O	2.12	0.49
1:A:39:SER:HA	1:A:67:VAL:HA	1.97	0.46
1:A:132:ILE:O	1:A:136:VAL:HG23	2.16	0.45
1:A:427:GLY:HA2	6:A:494:ADP:O3B	2.17	0.43
1:A:234:LYS:HD3	1:A:262:LEU:HD23	2.01	0.42
1:A:30:ALA:HB1	1:A:192:LYS:HD2	2.01	0.42
1:A:4:ILE:HG22	1:A:198:HIS:CD2	2.55	0.42
1:A:90:TYR:CZ	1:A:95:GLY:HA3	2.54	0.42
1:A:388:ALA:HB1	1:A:399:LEU:HD23	2.02	0.41
1:A:253:MET:HG3	1:A:279:PHE:CE2	2.55	0.41
1:A:120:GLY:HA3	5:A:493:NAI:O3	2.21	0.41
1:A:80:THR:HB	1:A:81:PRO:HD2	2.01	0.41
1:A:366:HIS:CE1	7:A:495:NAX:C8A	3.04	0.41
1:A:216:VAL:CG1	1:A:488:LEU:HD21	2.36	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	487/502 (97%)	473 (97%)	13 (3%)	1 (0%)	52	64
2	B	5/7 (71%)	5 (100%)	0	0	100	100
All	All	492/509 (97%)	478 (97%)	13 (3%)	1 (0%)	52	64

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	104	SER

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	410/422 (97%)	401 (98%)	9 (2%)	60	77
2	B	4/4 (100%)	4 (100%)	0	100	100
All	All	414/426 (97%)	405 (98%)	9 (2%)	60	77

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	77	LYS
1	A	91	LYS
1	A	114	ASP
1	A	209	TYR

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Mol	Chain	Res	Type
1	A	213	ARG
1	A	274	ILE
1	A	278	ARG
1	A	308	ASP

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 ⓘ

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 5 ligands modelled in this entry, 2 are monoatomic - leaving 3 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	NAI	A	493	-	31,39,48	0.89	2 (6%)	37,60,73	1.81	10 (27%)
6	ADP	A	494	4	22,29,29	1.27	3 (13%)	27,45,45	2.38	7 (25%)
7	NAX	A	495	-	38,49,49	0.92	2 (5%)	42,75,75	1.73	5 (11%)

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	NAI	A	493	-	-	0/18/54/72	0/4/4/5
6	ADP	A	494	4	-	0/12/32/32	0/3/3/3
7	NAX	A	495	-	-	0/25/75/75	0/5/5/5

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	494	ADP	PB-O2B	-2.34	1.46	1.54
5	A	493	NAI	PN-O1N	-2.01	1.46	1.54
6	A	494	ADP	C5-C4	2.07	1.45	1.40
7	A	495	NAX	C5A-C4A	2.26	1.45	1.40
5	A	493	NAI	C5A-C4A	2.44	1.46	1.40
7	A	495	NAX	O6N-C6N	2.82	1.45	1.41
6	A	494	ADP	O4'-C1'	2.90	1.44	1.41

All (22) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	A	494	ADP	N3-C2-N1	-9.15	121.89	128.89
7	A	495	NAX	N3A-C2A-N1A	-7.68	123.02	128.89
5	A	493	NAI	N3A-C2A-N1A	-7.02	123.52	128.89
6	A	494	ADP	O3B-PB-O3A	-3.51	89.18	105.09
7	A	495	NAX	C2B-C1B-N9A	-3.16	109.46	114.29
7	A	495	NAX	C1B-N9A-C4A	-2.93	122.53	126.94
7	A	495	NAX	O3-PA-O5B	-2.77	95.59	102.94
5	A	493	NAI	PN-O3-PA	-2.69	125.17	132.73
5	A	493	NAI	O4B-C1B-N9A	-2.51	102.85	108.10
6	A	494	ADP	C1'-N9-C4	-2.39	123.34	126.94
5	A	493	NAI	O3B-C3B-C4B	-2.22	104.41	111.05
5	A	493	NAI	O5B-PA-O1A	-2.01	101.81	109.62
5	A	493	NAI	C4B-O4B-C1B	2.03	111.95	109.72
5	A	493	NAI	O2A-PA-O1A	2.14	124.15	112.53
6	A	494	ADP	O3B-PB-O2B	2.31	116.16	107.38
6	A	494	ADP	C2-N1-C6	2.50	123.23	118.77
6	A	494	ADP	O2A-PA-O1A	2.57	126.47	112.53
5	A	493	NAI	N6A-C6A-N1A	2.63	124.85	119.20
6	A	494	ADP	O2B-PB-O3A	2.64	117.05	105.09
5	A	493	NAI	O2A-PA-O3	2.77	117.67	105.09
5	A	493	NAI	O1N-PN-O2N	2.78	127.58	112.53
7	A	495	NAX	O2A-PA-O3	2.79	117.73	105.09

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	493	NAI	1	0
6	A	494	ADP	2	0
7	A	495	NAX	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	489/502 (97%)	0.19	31 (6%) 23 31	27, 39, 70, 142	0
2	B	7/7 (100%)	0.24	1 (14%) 4 6	42, 46, 60, 62	0
All	All	496/509 (97%)	0.19	32 (6%) 22 30	27, 39, 70, 142	0

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	274	ILE	4.9
1	A	276	THR	4.7
2	B	1	ALA	4.7
1	A	277	SER	4.6
1	A	278	ARG	4.4
1	A	279	PHE	4.3
1	A	101	PHE	4.1
1	A	358	LYS	3.8
1	A	275	ALA	3.7
1	A	249	VAL	3.2
1	A	102	GLU	2.9
1	A	246	GLY	2.9
1	A	282	LEU	2.8
1	A	95	GLY	2.8
1	A	280	PRO	2.7
1	A	1	MET	2.7
1	A	247	ALA	2.4
1	A	355	LYS	2.4
1	A	475	SER	2.4
1	A	248	PRO	2.3
1	A	105	ILE	2.3
1	A	253	MET	2.3
1	A	273	LEU	2.3
1	A	356	GLU	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	290	GLU	2.2
1	A	128	GLU	2.2
1	A	213	ARG	2.2
1	A	107	ASN	2.0
1	A	291	LYS	2.0
1	A	207	ASN	2.0
1	A	396	ASP	2.0
1	A	41	TYR	2.0

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(Å ²)	Q<0.9
6	ADP	A	494	27/27	0.98	0.12	-0.21	27,31,35,42	0
7	NAX	A	495	45/45	0.96	0.13	-0.47	28,37,65,69	0
5	NAI	A	493	36/44	0.96	0.10	-0.81	33,45,54,54	0
3	K	A	491	1/1	0.99	0.07	-2.15	36,36,36,36	0
4	MG	A	492	1/1	0.99	0.05	-2.49	43,43,43,43	0

6.5 Other polymers [i](#)

There are no such residues in this entry.