



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 14, 2017 – 02:53 am GMT

PDB ID : 1X14
Title : Crystal structure of E. coli transhydrogenase domain I with bound NAD
Authors : Johansson, T.; Oswald, C.; Pedersen, A.; Tornroth, S.; Okvist, M.; Karlsson, B.G.; Rydstrom, J.; Krengel, U.
Deposited on : 2005-03-31
Resolution : 1.94 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 : 1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix) : 1.9-1692
EDS : trunk28620
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) : recalc28949

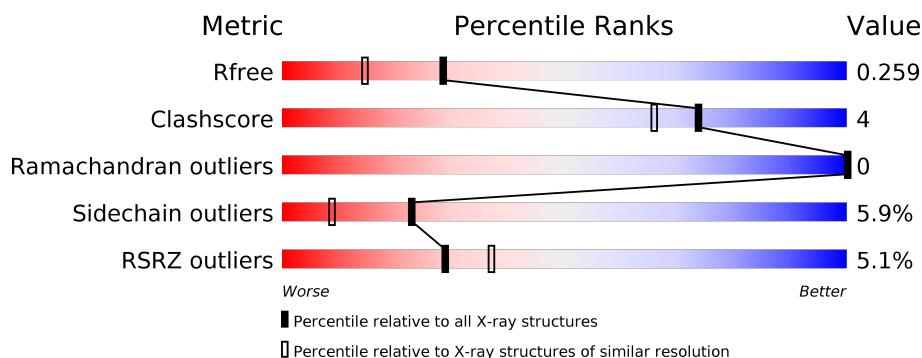
1 Overall quality at a glance

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}	100719	3233 (1.96-1.92)
Clashscore	112137	3430 (1.96-1.92)
Ramachandran outliers	110173	3395 (1.96-1.92)
Sidechain outliers	110143	3395 (1.96-1.92)
RSRZ outliers	101464	3250 (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. 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	401	<div> <div>5%</div> <div> <div></div> <div>81%</div> <div>10%</div> <div>9%</div> </div> </div>
1	B	401	<div> <div>4%</div> <div> <div></div> <div>77%</div> <div>12%</div> <div>9%</div> </div> </div>

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5673 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 NAD(P) transhydrogenase subunit alpha.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	366	Total	C	N	O	S	0	0	0
			2734	1734	463	525	12			
1	B	364	Total	C	N	O	S	0	0	0
			2728	1729	466	521	12			

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	994	MET	-	EXPRESSION TAG	UNP P07001
A	995	HIS	-	EXPRESSION TAG	UNP P07001
A	996	HIS	-	EXPRESSION TAG	UNP P07001
A	997	HIS	-	EXPRESSION TAG	UNP P07001
A	998	HIS	-	EXPRESSION TAG	UNP P07001
A	999	HIS	-	EXPRESSION TAG	UNP P07001
A	1000	HIS	-	EXPRESSION TAG	UNP P07001
A	1001	GLY	-	EXPRESSION TAG	UNP P07001
B	994	MET	-	EXPRESSION TAG	UNP P07001
B	995	HIS	-	EXPRESSION TAG	UNP P07001
B	996	HIS	-	EXPRESSION TAG	UNP P07001
B	997	HIS	-	EXPRESSION TAG	UNP P07001
B	998	HIS	-	EXPRESSION TAG	UNP P07001
B	999	HIS	-	EXPRESSION TAG	UNP P07001
B	1000	HIS	-	EXPRESSION TAG	UNP P07001
B	1001	GLY	-	EXPRESSION TAG	UNP P07001

- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: $C_{21}H_{27}N_7O_{14}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	B	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

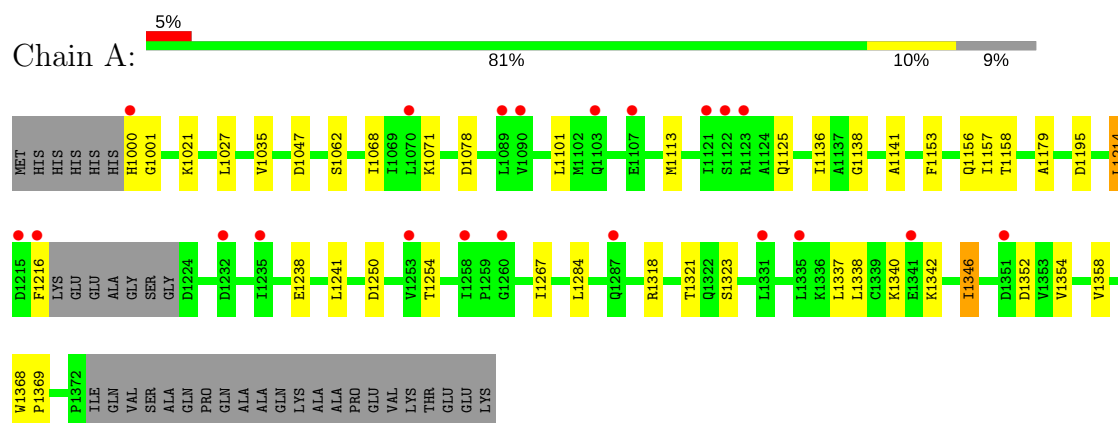
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	69	Total O	0	0
			69 69		
3	B	98	Total O	0	0
			98 98		

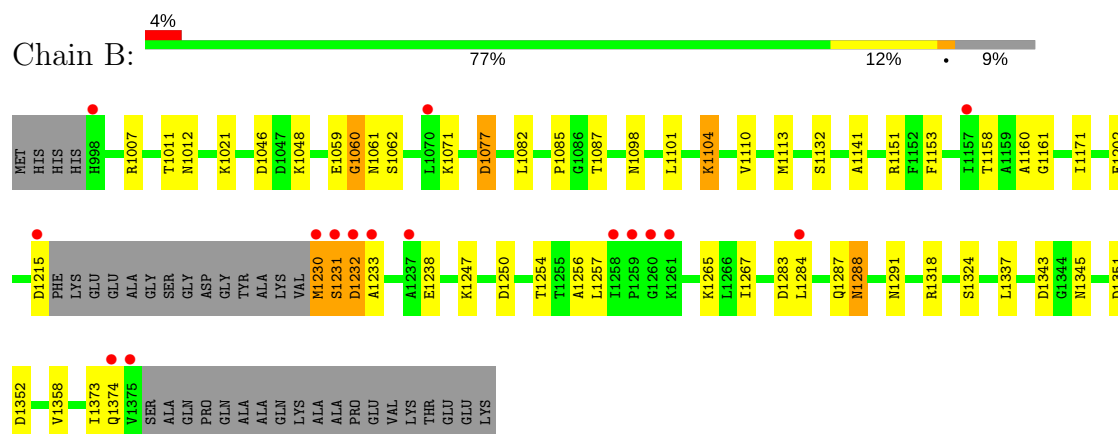
3 Residue-property plots [i](#)

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: NAD(P) transhydrogenase subunit alpha



- Molecule 1: NAD(P) transhydrogenase subunit alpha



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	38.77Å 66.98Å 76.62Å 67.08° 80.69° 80.99°	Depositor
Resolution (Å)	30.00 – 1.94 29.26 – 1.94	Depositor EDS
% Data completeness (in resolution range)	94.0 (30.00-1.94) 81.9 (29.26-1.94)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.63 (at 1.93Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.204 , 0.258 0.211 , 0.259	Depositor DCC
R_{free} test set	2435 reflections (5.29%)	DCC
Wilson B-factor (Å ²)	27.8	Xtriage
Anisotropy	0.445	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 45.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	5673	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.09% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: NAD

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	0.79	1/2778 (0.0%)	0.90	7/3774 (0.2%)
1	B	0.89	1/2772 (0.0%)	0.89	7/3766 (0.2%)
All	All	0.84	2/5550 (0.0%)	0.89	14/7540 (0.2%)

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	1
1	B	0	1
All	All	0	2

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	1324	SER	CB-OG	6.22	1.50	1.42
1	A	1035	VAL	CB-CG2	5.01	1.63	1.52

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1047	ASP	CB-CG-OD2	8.46	125.92	118.30
1	A	1318	ARG	NE-CZ-NH2	-8.32	116.14	120.30
1	A	1250	ASP	CB-CG-OD2	7.80	125.32	118.30
1	B	1343	ASP	CB-CG-OD2	7.27	124.84	118.30
1	A	1078	ASP	CB-CG-OD2	6.86	124.48	118.30
1	B	1351	ASP	CB-CG-OD2	6.73	124.36	118.30
1	B	1077	ASP	CB-CG-OD2	6.11	123.80	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1195	ASP	CB-CG-OD2	5.92	123.63	118.30
1	B	1250	ASP	CB-CG-OD2	5.73	123.46	118.30
1	B	1046	ASP	CB-CG-OD2	5.40	123.16	118.30
1	B	1352	ASP	CB-CG-OD2	5.35	123.11	118.30
1	A	1318	ARG	NE-CZ-NH1	5.29	122.94	120.30
1	A	1250	ASP	CB-CG-OD1	-5.27	113.56	118.30
1	B	1007	ARG	NE-CZ-NH2	-5.02	117.79	120.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1342	LYS	Peptide
1	B	1060	GLY	Peptide

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	2734	0	2770	19	0
1	B	2728	0	2778	25	0
2	B	44	0	26	1	0
3	A	69	0	0	0	0
3	B	98	0	0	3	0
All	All	5673	0	5574	42	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 4.

All (42) 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:1321:THR:HG21	1:B:1151:ARG:HH11	1.49	0.76
1:A:1000:HIS:CD2	1:A:1001:GLY:H	2.07	0.71
1:B:1011:THR:HG22	1:B:1012:ASN:ND2	2.04	0.71

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:1156:GLN:HE21	1:A:1158:THR:CG2	2.08	0.66
1:A:1000:HIS:CG	1:A:1001:GLY:N	2.64	0.65
1:B:1256:ALA:H	1:B:1291:ASN:HD21	1.46	0.64
1:B:1141:ALA:HB2	1:B:1284:LEU:HD11	1.79	0.63
1:A:1352:ASP:OD1	1:A:1354:VAL:HG22	1.99	0.63
1:B:1230:MET:HA	1:B:1231:SER:CB	2.31	0.61
1:B:1158:THR:HG22	1:B:1160:ALA:H	1.70	0.55
1:A:1000:HIS:CD2	1:A:1001:GLY:N	2.76	0.54
1:B:1151:ARG:NE	3:B:117:HOH:O	2.41	0.54
1:B:1230:MET:HA	1:B:1231:SER:HB2	1.89	0.53
1:A:1337:LEU:HD21	1:A:1354:VAL:HG21	1.89	0.53
1:A:1068:ILE:HD11	1:A:1346:ILE:CD1	2.39	0.52
1:A:1156:GLN:NE2	1:A:1158:THR:CG2	2.72	0.52
1:B:1257:LEU:HD21	1:B:1288:ASN:OD1	2.10	0.52
1:A:1113:MET:HB3	1:A:1358:VAL:HG12	1.93	0.51
1:B:1171:ILE:CD1	1:B:1267:ILE:HD11	2.41	0.50
1:A:1321:THR:HG21	1:B:1151:ARG:NH1	2.25	0.47
1:B:1232:ASP:O	1:B:1233:ALA:HB3	2.15	0.47
1:B:1113:MET:HG2	1:B:1358:VAL:HG13	1.96	0.47
1:B:1158:THR:HB	1:B:1161:GLY:O	2.15	0.46
1:A:1141:ALA:HB2	1:A:1284:LEU:HD21	1.98	0.46
1:B:1011:THR:HG22	1:B:1012:ASN:HD22	1.77	0.46
1:A:1254:THR:HG21	1:A:1267:ILE:HD12	1.99	0.45
1:B:1254:THR:HG22	1:B:1283:ASP:HA	1.98	0.45
1:A:1368:TRP:CD1	1:A:1369:PRO:HA	2.51	0.44
1:A:1337:LEU:CD2	1:A:1354:VAL:HG21	2.47	0.44
1:B:1238:GLU:OE1	2:B:1395:NAD:N1A	2.51	0.43
1:A:1156:GLN:NE2	1:A:1158:THR:HG22	2.33	0.43
1:A:1138:GLY:HA3	1:A:1179:ALA:HB3	2.02	0.42
1:B:1087:THR:HB	1:B:1110:VAL:HG12	2.01	0.42
1:B:1098:ASN:HB3	1:B:1101:LEU:HB3	2.02	0.42
1:B:1060:GLY:C	1:B:1062:SER:H	2.22	0.41
1:B:1151:ARG:NH2	3:B:79:HOH:O	2.53	0.41
1:A:1214:LEU:HD11	1:A:1238:GLU:HA	2.01	0.41
1:B:1318:ARG:HD3	3:B:12:HOH:O	2.19	0.41
1:A:1136:ILE:CD1	1:A:1323:SER:HA	2.50	0.41
1:B:1077:ASP:OD1	1:B:1104:LYS:NZ	2.45	0.41
1:B:1061:ASN:HB3	1:B:1082:LEU:HD13	2.02	0.41
1:B:1071:LYS:NZ	1:B:1071:LYS:HB3	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	362/401 (90%)	350 (97%)	12 (3%)	0	100	100
1	B	360/401 (90%)	346 (96%)	14 (4%)	0	100	100
All	All	722/802 (90%)	696 (96%)	26 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	288/317 (91%)	274 (95%)	14 (5%)	29	13
1	B	290/317 (92%)	270 (93%)	20 (7%)	18	6
All	All	578/634 (91%)	544 (94%)	34 (6%)	23	9

All (34) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1021	LYS
1	A	1027	LEU
1	A	1062	SER
1	A	1071	LYS
1	A	1101	LEU
1	A	1125	GLN
1	A	1153	PHE
1	A	1157	ILE

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Mol	Chain	Res	Type
1	A	1214	LEU
1	A	1216	PHE
1	A	1241	LEU
1	A	1338	LEU
1	A	1340	LYS
1	A	1346	ILE
1	B	1021	LYS
1	B	1048	LYS
1	B	1059	GLU
1	B	1085	PRO
1	B	1104	LYS
1	B	1132	SER
1	B	1153	PHE
1	B	1202	GLU
1	B	1215	ASP
1	B	1230	MET
1	B	1231	SER
1	B	1232	ASP
1	B	1247	LYS
1	B	1265	LYS
1	B	1287	GLN
1	B	1288	ASN
1	B	1337	LEU
1	B	1345	ASN
1	B	1373	ILE
1	B	1374	GLN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1000	HIS
1	A	1135	ASN
1	A	1156	GLN
1	A	1287	GLN
1	B	1012	ASN
1	B	1061	ASN
1	B	1135	ASN
1	B	1156	GLN
1	B	1291	ASN

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 ⓘ

1 ligand is modelled in this entry.

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	$\# Z > 2$
2	NAD	B	1395	-	41,48,48	1.71	4 (9%)	43,73,73	2.11	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
2	NAD	B	1395	-	-	0/22/62/62	0/5/5/5

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1395	NAD	C2B-C1B	-2.02	1.50	1.53
2	B	1395	NAD	C2A-N1A	3.59	1.40	1.33
2	B	1395	NAD	C2A-N3A	3.72	1.38	1.32
2	B	1395	NAD	O7N-C7N	8.14	1.41	1.24

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	1395	NAD	N3A-C2A-N1A	-9.71	120.40	128.86
2	B	1395	NAD	C4B-O4B-C1B	-6.86	102.47	109.77
2	B	1395	NAD	C1B-N9A-C4A	-3.45	120.67	126.64
2	B	1395	NAD	O7N-C7N-N7N	-2.08	119.62	122.58
2	B	1395	NAD	C3N-C7N-N7N	2.72	120.88	117.77

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	1395	NAD	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	366/401 (91%)	0.26	21 (5%) 24 32	18, 37, 56, 64	0
1	B	364/401 (90%)	0.17	16 (4%) 35 44	20, 34, 54, 80	0
All	All	730/802 (91%)	0.22	37 (5%) 29 37	18, 36, 56, 80	0

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1000	HIS	6.7
1	B	1231	SER	4.7
1	B	1215	ASP	4.6
1	A	1215	ASP	4.5
1	B	1232	ASP	4.5
1	A	1216	PHE	4.2
1	B	1260	GLY	4.0
1	B	1230	MET	3.8
1	A	1122	SER	3.8
1	B	1375	VAL	3.7
1	B	1237	ALA	3.4
1	B	998	HIS	3.1
1	A	1123	ARG	3.1
1	A	1090	VAL	3.1
1	A	1121	ILE	3.1
1	B	1259	PRO	3.0
1	B	1374	GLN	3.0
1	A	1341	GLU	2.8
1	A	1232	ASP	2.8
1	A	1070	LEU	2.7
1	B	1070	LEU	2.7
1	A	1331	LEU	2.5
1	B	1157	ILE	2.5
1	B	1258	ILE	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	1260	GLY	2.4
1	B	1261	LYS	2.4
1	A	1235	ILE	2.4
1	A	1335	LEU	2.3
1	A	1287	GLN	2.3
1	B	1233	ALA	2.3
1	A	1107	GLU	2.3
1	A	1351	ASP	2.2
1	A	1253	VAL	2.1
1	A	1103	GLN	2.1
1	A	1258	ILE	2.1
1	A	1089	LEU	2.1
1	B	1284	LEU	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(\AA^2)	Q<0.9
2	NAD	B	1395	44/44	0.91	0.15	0.83	42,51,77,77	0

6.5 Other polymers [i](#)

There are no such residues in this entry.