



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2018 – 11:00 pm GMT

PDB ID : 3AK4
Title : Crystal structure of NADH-dependent quinuclidinone reductase from agrobacterium tumefaciens
Authors : Miyakawa, T.; Kataoka, M.; Takeshita, D.; Nomoto, F.; Nagata, K.; Shimizu, S.; Tanokura, M.
Deposited on : 2010-07-07
Resolution : 2.00 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

<https://www.wwpdb.org/validation/2017/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 : 1.7.3 (157068), CSD as539be (2018)
Xtrriage (Phenix) : 1.13
EDS : trunk30967
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)
Refmac : 5.8.0158
CCP4 : 7.0 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : trunk30967

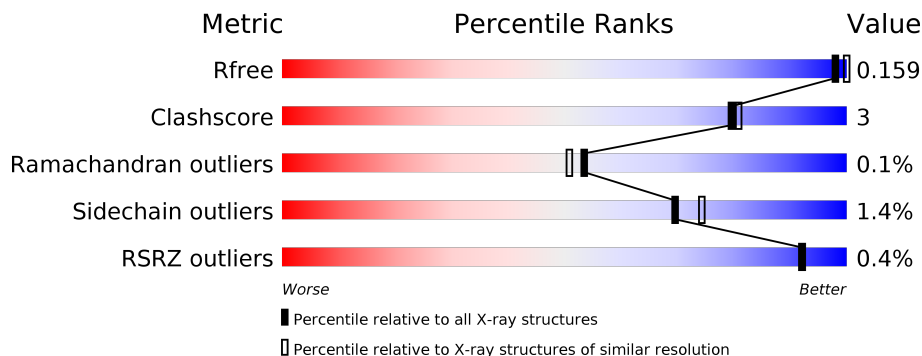
1 Overall quality at a glance

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}	111664	7193 (2.00-2.00)
Clashscore	122126	8267 (2.00-2.00)
Ramachandran outliers	120053	8166 (2.00-2.00)
Sidechain outliers	120020	8165 (2.00-2.00)
RSRZ outliers	108989	7011 (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	263	 91% 7%
1	B	263	 95%
1	C	263	 92% 6%
1	D	263	 90% 7%

2 Entry composition [i](#)

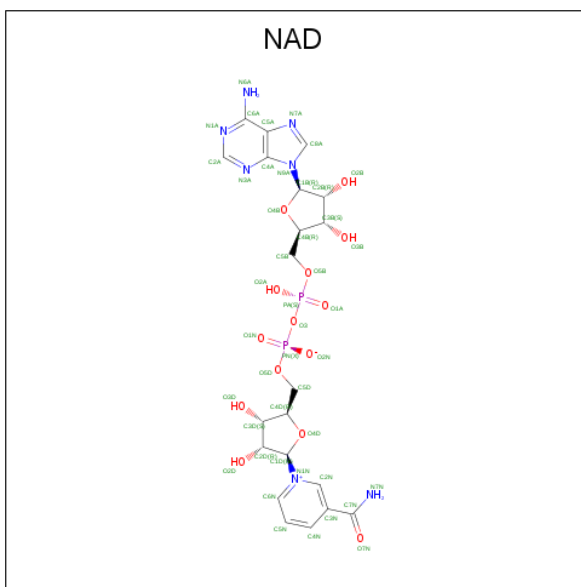
There are 3 unique types of molecules in this entry. The entry contains 8592 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 NADH-dependent quinuclidinone reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	258	Total 1899	C 1194	N 333	O 360	S 12	0	0	0
1	B	258	Total 1899	C 1194	N 333	O 360	S 12	0	0	0
1	C	258	Total 1899	C 1194	N 333	O 360	S 12	0	0	0
1	D	258	Total 1899	C 1194	N 333	O 360	S 12	0	0	0

- 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	
			Total	C	N	O			P
2	A	1	Total 44	C 21	N 7	O 14	P 2	0	0
2	B	1	Total 44	C 21	N 7	O 14	P 2	0	0

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	C	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	D	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	199	Total	O	0	0
			199	199		
3	B	194	Total	O	0	0
			194	194		
3	C	223	Total	O	0	0
			223	223		
3	D	204	Total	O	0	0
			204	204		

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: NADH-dependent quinuclidinone reductase

Chain A: 



- Molecule 1: NADH-dependent quinuclidinone reductase

Chain B: 




- Molecule 1: NADH-dependent quinuclidinone reductase

Chain C: 



- Molecule 1: NADH-dependent quinuclidinone reductase

Chain D: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	62.55Å 127.30Å 62.48Å 90.00° 110.40° 90.00°	Depositor
Resolution (Å)	20.00 – 2.00 19.73 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.0 (20.00-2.00) 99.0 (19.73-2.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.04	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.77 (at 2.01Å)	Xtrriage
Refinement program	REFMAC 5.3	Depositor
R, R_{free}	0.149 , 0.191 0.151 , 0.159	Depositor DCC
R_{free} test set	3092 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	18.1	Xtrriage
Anisotropy	0.052	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 51.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.024 for l,-k,h	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	8592	wwPDB-VP
Average B, all atoms (Å ²)	15.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.69% 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:
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	0.88	0/1927	0.72	0/2611
1	B	0.90	0/1927	0.72	0/2611
1	C	0.90	0/1927	0.71	0/2611
1	D	0.90	0/1927	0.74	1/2611 (0.0%)
All	All	0.90	0/7708	0.72	1/10444 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	27	ARG	NE-CZ-NH2	-5.31	117.65	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	1899	0	1904	13	0
1	B	1899	0	1904	7	0
1	C	1899	0	1904	15	0
1	D	1899	0	1904	11	0
2	A	44	0	26	0	0
2	B	44	0	26	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	44	0	26	0	0
2	D	44	0	26	0	0
3	A	199	0	0	1	0
3	B	194	0	0	2	0
3	C	223	0	0	1	0
3	D	204	0	0	3	0
All	All	8592	0	7720	46	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 (46) 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:C:122:ASN:HD21	1:C:140:ASN:HD21	1.26	0.83
1:B:122:ASN:HD21	1:B:140:ASN:HD21	1.26	0.80
1:A:122:ASN:HD21	1:A:140:ASN:HD21	1.26	0.79
1:C:194:GLN:HE21	1:C:213:ARG:HH11	1.32	0.77
1:C:58:PHE:CE2	1:C:60:VAL:CG1	2.68	0.77
1:D:122:ASN:HD21	1:D:140:ASN:HD21	1.30	0.75
1:A:58:PHE:CE2	1:A:60:VAL:CG1	2.72	0.72
1:C:27:ARG:NE	3:C:804:HOH:O	2.11	0.66
1:A:58:PHE:CE2	1:A:60:VAL:HG13	2.30	0.66
1:C:201:GLU:OE2	1:C:205:ARG:NH1	2.32	0.59
1:D:96:MET:HE2	1:D:204:LEU:HD12	1.86	0.58
1:D:58:PHE:CE2	1:D:60:VAL:HG13	2.38	0.58
1:C:58:PHE:CE2	1:C:60:VAL:HG13	2.37	0.57
1:B:27:ARG:NH1	3:B:314:HOH:O	2.37	0.56
1:C:58:PHE:HE2	1:C:60:VAL:CG1	2.19	0.56
1:C:194:GLN:HE21	1:C:213:ARG:NH1	2.03	0.56
1:A:11:LYS:HE2	3:A:612:HOH:O	2.08	0.54
1:A:78:ILE:HG12	1:A:84:PHE:HB2	1.90	0.54
1:C:194:GLN:NE2	1:C:213:ARG:HH11	2.05	0.53
1:D:122:ASN:HD22	1:D:166:TRP:HE1	1.56	0.52
1:A:222:LEU:HD12	1:A:255:GLY:HA2	1.91	0.52
1:B:4:ILE:H	1:B:4:ILE:HD13	1.74	0.52
1:C:122:ASN:HD22	1:C:166:TRP:HE1	1.60	0.49
1:D:97:ARG:HD2	1:D:106:GLU:OE2	2.13	0.49
1:B:122:ASN:HD22	1:B:166:TRP:HE1	1.61	0.48
1:A:194:GLN:HE21	1:A:213:ARG:HH11	1.62	0.47
1:A:132:SER:HG	1:A:134:THR:HG1	1.63	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:222:LEU:HD12	1:C:255:GLY:HA2	1.97	0.47
1:A:58:PHE:HE2	1:A:60:VAL:CG1	2.22	0.46
1:B:122:ASN:ND2	1:B:166:TRP:HE1	2.13	0.46
1:D:122:ASN:ND2	1:D:166:TRP:HE1	2.13	0.46
1:C:201:GLU:HG2	1:C:205:ARG:HD3	1.97	0.45
1:D:10:ARG:HD2	3:D:291:HOH:O	2.16	0.45
1:A:122:ASN:ND2	1:A:166:TRP:HE1	2.16	0.43
1:A:122:ASN:HD22	1:A:166:TRP:HE1	1.65	0.43
1:A:174:MET:HB3	1:A:179:ILE:HB	2.00	0.43
1:C:135:LYS:O	1:C:135:LYS:CG	2.66	0.43
1:C:76:LYS:HB3	1:C:76:LYS:HE3	1.74	0.43
1:B:224:ARG:NH2	3:B:639:HOH:O	2.40	0.42
1:D:222:LEU:HD12	1:D:255:GLY:HA2	2.01	0.42
1:D:177:LYS:HE2	3:D:748:HOH:O	2.19	0.42
1:A:167:THR:HG23	1:A:181:VAL:HG12	2.01	0.42
1:C:122:ASN:ND2	1:C:166:TRP:HE1	2.18	0.42
1:D:4:ILE:HD12	1:D:5:PHE:CD2	2.55	0.41
1:B:4:ILE:N	1:B:4:ILE:HD13	2.35	0.41
1:D:4:ILE:HG13	3:D:516:HOH:O	2.21	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	256/263 (97%)	249 (97%)	7 (3%)	0	100	100
1	B	256/263 (97%)	249 (97%)	6 (2%)	1 (0%)	36	31
1	C	256/263 (97%)	250 (98%)	6 (2%)	0	100	100
1	D	256/263 (97%)	249 (97%)	7 (3%)	0	100	100
All	All	1024/1052 (97%)	997 (97%)	26 (2%)	1 (0%)	53	51

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	142	ALA

5.3.2 Protein sidechains [i](#)

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	190/193 (98%)	189 (100%)	1 (0%)	90	93
1	B	190/193 (98%)	188 (99%)	2 (1%)	76	80
1	C	190/193 (98%)	187 (98%)	3 (2%)	65	70
1	D	190/193 (98%)	185 (97%)	5 (3%)	49	50
All	All	760/772 (98%)	749 (99%)	11 (1%)	69	74

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	71	ASP
1	B	4	ILE
1	B	71	ASP
1	C	41	LEU
1	C	97	ARG
1	C	135	LYS
1	D	19	LYS
1	D	43	VAL
1	D	44	MET
1	D	60	VAL
1	D	148	VAL

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	75	GLN
1	A	122	ASN
1	A	194	GLN

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Mol	Chain	Res	Type
1	B	47	GLN
1	B	75	GLN
1	B	122	ASN
1	C	47	GLN
1	C	122	ASN
1	C	194	GLN
1	D	75	GLN
1	D	122	ASN

5.3.3 RNA [i](#)

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](#)

4 ligands are 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	A	901	-	40,48,48	0.94	1 (2%)	44,73,73	2.03	7 (15%)
2	NAD	B	902	-	40,48,48	0.94	2 (5%)	44,73,73	1.74	6 (13%)
2	NAD	C	903	-	40,48,48	0.91	3 (7%)	44,73,73	1.85	7 (15%)
2	NAD	D	904	-	40,48,48	0.92	1 (2%)	44,73,73	1.83	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	A	901	-	-	0/22/62/62	0/5/5/5
2	NAD	B	902	-	-	0/22/62/62	0/5/5/5
2	NAD	C	903	-	-	0/22/62/62	0/5/5/5
2	NAD	D	904	-	-	0/22/62/62	0/5/5/5

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	903	NAD	C8A-N9A	-2.11	1.34	1.36
2	B	902	NAD	C2A-N3A	2.05	1.35	1.32
2	A	901	NAD	C3N-C7N	2.06	1.53	1.50
2	C	903	NAD	O4B-C1B	2.29	1.44	1.41
2	D	904	NAD	O4D-C1D	2.67	1.45	1.41
2	B	902	NAD	O4B-C1B	2.73	1.45	1.41
2	C	903	NAD	O4D-C1D	2.80	1.45	1.41

All (25) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	901	NAD	N3A-C2A-N1A	-10.77	119.65	128.86
2	D	904	NAD	N3A-C2A-N1A	-10.20	120.13	128.86
2	B	902	NAD	N3A-C2A-N1A	-9.13	121.05	128.86
2	C	903	NAD	N3A-C2A-N1A	-8.68	121.44	128.86
2	C	903	NAD	C4A-C5A-N7A	-3.26	106.26	109.41
2	A	901	NAD	C1B-N9A-C4A	-3.19	121.13	126.64
2	B	902	NAD	C4A-C5A-N7A	-2.68	106.82	109.41
2	C	903	NAD	C3N-C2N-N1N	-2.61	117.80	120.41
2	C	903	NAD	C1B-N9A-C4A	-2.39	122.50	126.64
2	A	901	NAD	O7N-C7N-N7N	-2.39	119.13	122.60
2	D	904	NAD	C1B-N9A-C4A	-2.34	122.59	126.64
2	B	902	NAD	C1B-N9A-C4A	-2.31	122.64	126.64
2	C	903	NAD	O7N-C7N-C3N	-2.30	116.74	119.62
2	D	904	NAD	C4A-C5A-N7A	-2.16	107.32	109.41
2	D	904	NAD	O7N-C7N-N7N	-2.15	119.46	122.60
2	B	902	NAD	O7N-C7N-N7N	-2.07	119.58	122.60
2	A	901	NAD	O2N-PN-O1N	2.04	122.53	112.14
2	C	903	NAD	O2A-PA-O1A	2.07	122.66	112.14
2	B	902	NAD	O2A-PA-O1A	2.17	123.14	112.14

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	902	NAD	C3N-C7N-N7N	2.31	120.44	117.76
2	A	901	NAD	C2A-N1A-C6A	2.42	122.86	118.75
2	D	904	NAD	C2A-N1A-C6A	2.52	123.04	118.75
2	A	901	NAD	N6A-C6A-N1A	2.58	123.93	118.57
2	C	903	NAD	C3N-C7N-N7N	2.74	120.94	117.76
2	A	901	NAD	C3N-C7N-N7N	3.43	121.74	117.76

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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	258/263 (98%)	-0.61	0 100 100	8, 13, 22, 32	0
1	B	258/263 (98%)	-0.59	1 (0%) 92 92	8, 13, 25, 31	0
1	C	258/263 (98%)	-0.63	1 (0%) 92 92	7, 13, 23, 29	0
1	D	258/263 (98%)	-0.49	2 (0%) 86 85	7, 14, 32, 47	0
All	All	1032/1052 (98%)	-0.58	4 (0%) 92 92	7, 13, 25, 47	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	206	GLY	2.9
1	D	193	MET	2.7
1	C	58	PHE	2.5
1	B	3	GLY	2.3

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. 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	B-factors(\AA^2)	Q<0.9
2	NAD	D	904	44/44	0.93	0.13	14,22,40,41	0
2	NAD	B	902	44/44	0.95	0.10	11,19,24,26	0
2	NAD	A	901	44/44	0.97	0.08	8,15,26,28	0
2	NAD	C	903	44/44	0.98	0.07	8,14,19,21	0

6.5 Other polymers [i](#)

There are no such residues in this entry.