



Full wwPDB X-ray Structure Validation Report ⓘ

Oct 17, 2021 – 06:31 AM EDT

PDB ID : 1MGO
Title : Horse Liver Alcohol Dehydrogenase Phe93Ala Mutant
Authors : Rubach, J.K.; Plapp, B.V.
Deposited on : 2002-08-15
Resolution : 1.20 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 : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.23.2
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.23.2

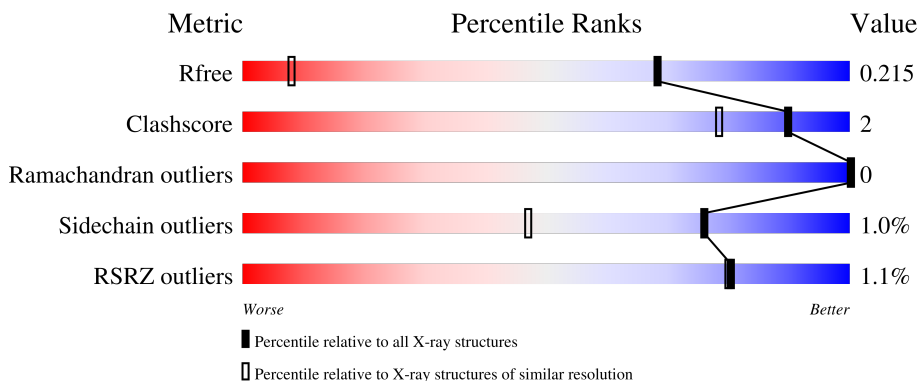
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.20 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}	130704	1223 (1.22-1.18)
Clashscore	141614	1286 (1.22-1.18)
Ramachandran outliers	138981	1240 (1.22-1.18)
Sidechain outliers	138945	1239 (1.22-1.18)
RSRZ outliers	127900	1200 (1.22-1.18)

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 of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. 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	374	 95% 5%
1	B	374	 97%

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 6151 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 Alcohol Dehydrogenase E chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	374	2781	1764	473	521	23	0	1	0
1	B	374	2779	1763	472	521	23	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	93	ALA	PHE	engineered mutation	UNP P00327
B	93	ALA	PHE	engineered mutation	UNP P00327

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

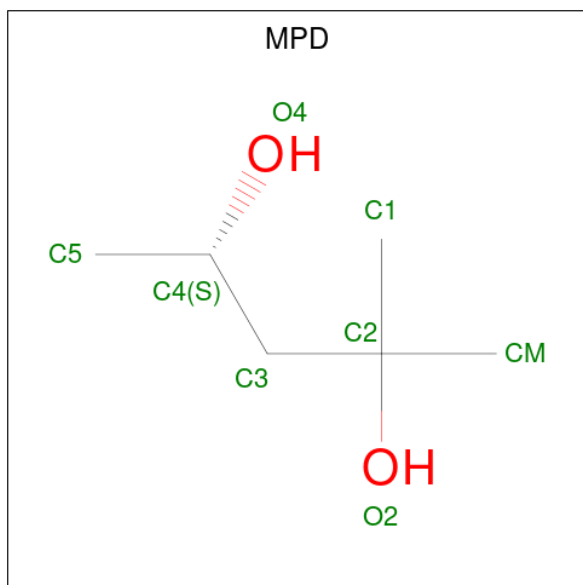
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Zn	0	0
			2	2		
2	B	2	Total	Zn	0	0
			2	2		

- Molecule 3 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: C₂₁H₂₇N₇O₁₄P₂).

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	
4	B	1	Total	C	F	O	0	0
			13	7	5	1		

- Molecule 5 is (4S)-2-METHYL-2,4-PENTANEDIOL (three-letter code: MPD) (formula: C₆H₁₄O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	B	1	Total	C	O	0	0
			8	6	2		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	203	Total	O	0	0
			203	203		
6	B	262	Total	O	0	0
			262	262		

4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	44.14Å 51.31Å 93.48Å 91.98° 103.01° 109.81°	Depositor
Resolution (Å)	20.00 – 1.20 19.97 – 1.20	Depositor EDS
% Data completeness (in resolution range)	86.3 (20.00-1.20) 86.3 (19.97-1.20)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.20 (at 1.20Å)	Xtrriage
Refinement program	REFMAC 5.1.27	Depositor
R, R_{free}	0.188 , 0.209 0.195 , 0.215	Depositor DCC
R_{free} test set	2017 reflections (1.00%)	wwPDB-VP
Wilson B-factor (Å ²)	15.5	Xtrriage
Anisotropy	0.162	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 39.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.35$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	6151	wwPDB-VP
Average B, all atoms (Å ²)	19.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.70% 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: ZN, PFB, MPD, 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	1/2839 (0.0%)	0.92	9/3836 (0.2%)
1	B	0.90	0/2830	0.95	5/3825 (0.1%)
All	All	0.89	1/5669 (0.0%)	0.94	14/7661 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	239	GLU	CD-OE2	5.42	1.31	1.25

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	273	ASP	CB-CG-OD1	7.13	124.72	118.30
1	A	161	ASP	CB-CG-OD1	6.33	123.99	118.30
1	B	61	LEU	CB-CG-CD1	6.04	121.26	111.00
1	B	115	ASP	CB-CG-OD2	5.76	123.49	118.30
1	A	297	ASP	CB-CG-OD2	5.69	123.42	118.30
1	A	336	MET	CG-SD-CE	5.43	108.90	100.20
1	B	161	ASP	CB-CG-OD1	5.41	123.17	118.30
1	A	153	ASP	CB-CG-OD2	5.25	123.03	118.30
1	B	312	ARG	NE-CZ-NH1	5.23	122.92	120.30
1	A	47	ARG	NE-CZ-NH1	5.22	122.91	120.30
1	A	273	ASP	CB-CG-OD1	5.22	123.00	118.30
1	A	47	ARG	NE-CZ-NH2	-5.17	117.72	120.30
1	A	245	ASP	CB-CG-OD1	5.09	122.88	118.30
1	A	87	ASP	CB-CG-OD1	5.06	122.85	118.30

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	2781	0	2845	16	0
1	B	2779	0	2844	7	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
3	A	44	0	26	0	0
3	B	44	0	26	0	0
4	B	26	0	6	1	0
5	B	8	0	14	0	0
6	A	203	0	0	1	0
6	B	262	0	0	1	0
All	All	6151	0	5761	21	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 2.

All (21) 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:228[B]:LYS:NZ	6:A:580:HOH:O	1.59	1.02
1:B:309:LEU:HD23	4:B:601:PF3:F3	1.62	0.87
1:A:336:MET:HA	1:A:336:MET:CE	2.10	0.81
1:A:40:MET:HA	1:A:40:MET:HE2	1.63	0.80
1:A:336:MET:HA	1:A:336:MET:HE3	1.67	0.75
1:A:40:MET:HE2	1:A:40:MET:CA	2.28	0.62
1:A:40:MET:CA	1:A:40:MET:CE	2.81	0.59
1:A:40:MET:HA	1:A:40:MET:CE	2.36	0.54
1:A:336:MET:HA	1:A:336:MET:HE2	1.92	0.49
1:A:238:THR:C	1:A:239:GLU:HG3	2.33	0.48
1:A:336:MET:HE3	1:A:336:MET:CA	2.42	0.48
1:A:70:ALA:HB1	1:A:166:LEU:HD22	1.96	0.47
1:A:336:MET:CE	1:A:336:MET:CA	2.89	0.46
1:A:123:MET:SD	1:A:139:HIS:CE1	3.10	0.45
1:A:295:PRO:HD2	1:B:306:MET:CE	2.47	0.44
1:B:56:THR:HA	6:B:756:HOH:O	2.18	0.43
1:B:350:LEU:O	1:B:372:LEU:HA	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:295:PRO:HD2	1:B:306:MET:HE1	2.02	0.42
1:B:301:LEU:HD12	1:B:301:LEU:C	2.40	0.42
1:B:40:MET:HE3	1:B:40:MET:HB2	1.93	0.41
1:A:238:THR:O	1:A:239:GLU:HG3	2.20	0.41

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	373/374 (100%)	363 (97%)	10 (3%)	0	100	100
1	B	372/374 (100%)	361 (97%)	11 (3%)	0	100	100
All	All	745/748 (100%)	724 (97%)	21 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	308/307 (100%)	303 (98%)	5 (2%)	62	27
1	B	307/307 (100%)	306 (100%)	1 (0%)	92	79
All	All	615/614 (100%)	609 (99%)	6 (1%)	76	47

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	40	MET
1	A	118	MET
1	A	281	CYS
1	A	300	ASN
1	A	336	MET
1	B	61	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	34	HIS
1	A	300	ASN
1	B	251	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 9 ligands modelled in this entry, 4 are monoatomic - leaving 5 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	NAD	A	377	-	42,48,48	1.01	2 (4%)	50,73,73	1.69	12 (24%)
3	NAD	B	377	-	42,48,48	1.00	4 (9%)	50,73,73	1.75	10 (20%)
5	MPD	B	602	-	7,7,7	0.80	0	9,10,10	0.70	0
4	PFB	B	601	-	13,13,13	2.95	1 (7%)	19,19,19	1.21	2 (10%)
4	PFB	B	600	-	13,13,13	3.29	1 (7%)	19,19,19	1.87	7 (36%)

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	NAD	A	377	-	-	5/26/62/62	0/5/5/5
3	NAD	B	377	-	-	5/26/62/62	0/5/5/5
5	MPD	B	602	-	-	0/5/5/5	-
4	PFB	B	601	-	-	2/2/2/2	0/1/1/1
4	PFB	B	600	-	-	1/2/2/2	0/1/1/1

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	600	PFB	C7-C1	-11.75	1.38	1.51
4	B	601	PFB	C7-C1	-10.52	1.39	1.51
3	A	377	NAD	C4N-C3N	2.83	1.44	1.39
3	B	377	NAD	C7N-N7N	2.55	1.37	1.33
3	A	377	NAD	C2B-C1B	2.44	1.57	1.53
3	B	377	NAD	C4N-C3N	2.31	1.43	1.39
3	B	377	NAD	O4D-C1D	2.20	1.44	1.41
3	B	377	NAD	C2N-N1N	2.08	1.37	1.35

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	377	NAD	C5N-C4N-C3N	-4.46	115.06	120.34
3	A	377	NAD	C3N-C2N-N1N	4.39	124.72	120.43
3	B	377	NAD	C2A-N1A-C6A	4.35	126.19	118.75
3	B	377	NAD	N3A-C2A-N1A	-4.20	122.12	128.68
4	B	600	PFB	C6-C1-C2	4.17	120.83	115.90
3	B	377	NAD	C5A-C6A-N6A	3.89	126.26	120.35
3	A	377	NAD	N3A-C2A-N1A	-3.75	122.81	128.68

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	377	NAD	C2A-N1A-C6A	3.69	125.07	118.75
3	A	377	NAD	O7N-C7N-C3N	-3.61	115.31	119.63
3	B	377	NAD	C5A-C6A-N1A	-3.42	112.61	120.35
3	B	377	NAD	C6N-C5N-C4N	3.36	124.32	119.44
3	A	377	NAD	O4B-C1B-C2B	-3.11	102.39	106.93
3	A	377	NAD	C6N-N1N-C2N	-3.08	119.17	121.97
3	A	377	NAD	C5A-C6A-N1A	-3.06	113.42	120.35
4	B	600	PFB	F6-C6-C1	2.99	122.94	119.32
4	B	601	PFB	C6-C1-C2	2.78	119.19	115.90
4	B	600	PFB	C1-C2-C3	-2.72	119.15	122.37
4	B	600	PFB	C1-C6-C5	-2.64	119.25	122.37
3	B	377	NAD	O4D-C1D-C2D	-2.59	103.14	106.93
4	B	601	PFB	C1-C2-C3	-2.50	119.41	122.37
4	B	600	PFB	F2-C2-C1	2.46	122.31	119.32
3	B	377	NAD	O2N-PN-O1N	2.46	124.40	112.24
3	A	377	NAD	C5A-C6A-N6A	2.40	124.00	120.35
3	B	377	NAD	O3D-C3D-C2D	-2.35	104.23	111.82
3	A	377	NAD	C2N-C3N-C4N	-2.31	115.64	118.26
3	A	377	NAD	O7N-C7N-N7N	2.29	125.83	122.58
4	B	600	PFB	C7-C1-C2	-2.28	119.15	121.80
3	A	377	NAD	C6N-C5N-C4N	2.26	122.72	119.44
3	B	377	NAD	C5N-C6N-N1N	-2.09	117.41	120.40
3	A	377	NAD	C3D-C2D-C1D	-2.01	97.94	100.98
4	B	600	PFB	C5-C4-C3	2.01	121.76	119.53

There are no chirality outliers.

All (13) torsion outliers are listed below:

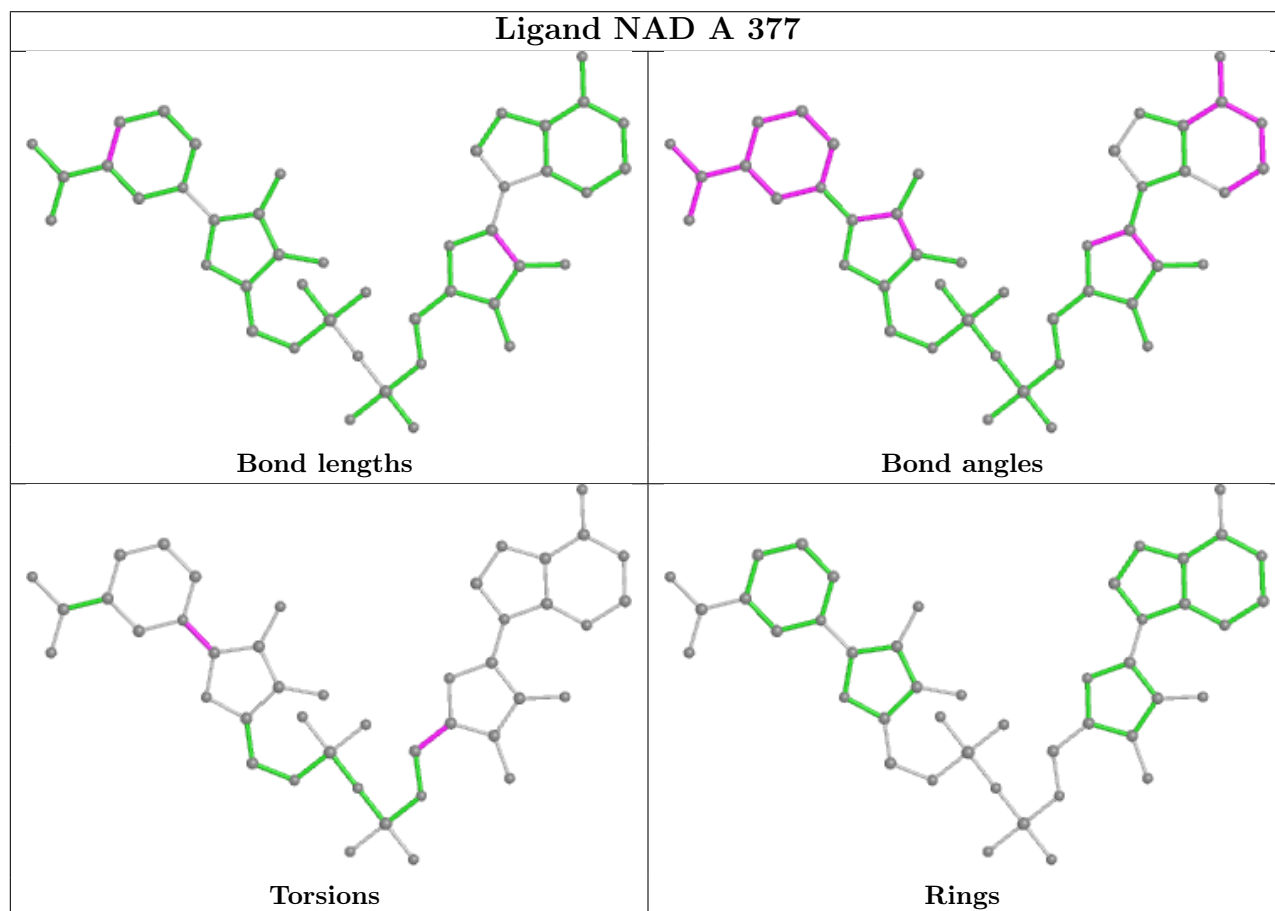
Mol	Chain	Res	Type	Atoms
3	A	377	NAD	O4D-C1D-N1N-C2N
3	A	377	NAD	O4D-C1D-N1N-C6N
3	A	377	NAD	C2D-C1D-N1N-C2N
3	A	377	NAD	C2D-C1D-N1N-C6N
3	B	377	NAD	O4D-C1D-N1N-C2N
3	B	377	NAD	O4D-C1D-N1N-C6N
3	B	377	NAD	C2D-C1D-N1N-C2N
3	B	377	NAD	C2D-C1D-N1N-C6N
4	B	601	PFB	C6-C1-C7-O1
4	B	601	PFB	C2-C1-C7-O1
3	A	377	NAD	O4B-C4B-C5B-O5B
4	B	600	PFB	C6-C1-C7-O1
3	B	377	NAD	O4B-C4B-C5B-O5B

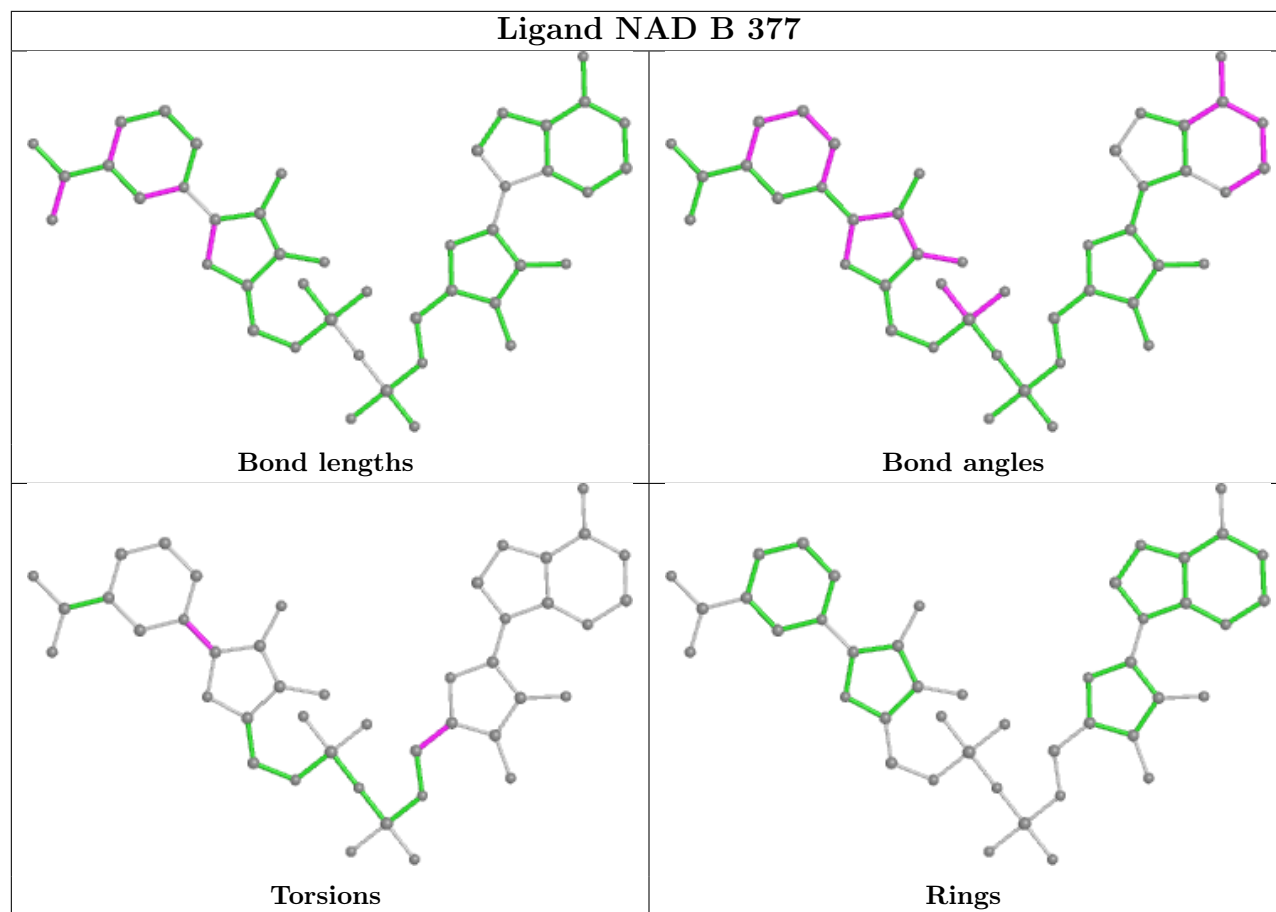
There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	B	601	PFB	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





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	374/374 (100%)	0.09	5 (1%) 77 77	12, 19, 28, 36	0
1	B	374/374 (100%)	-0.00	3 (0%) 86 86	12, 17, 25, 35	0
All	All	748/748 (100%)	0.04	8 (1%) 80 80	12, 18, 27, 36	0

All (8) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1	SER	6.3
1	B	1	SER	3.6
1	A	84	ARG	2.8
1	A	134	GLY	2.5
1	B	84	ARG	2.3
1	A	33	ALA	2.2
1	A	78	GLU	2.1
1	B	78	GLU	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 monosaccharides in this entry.

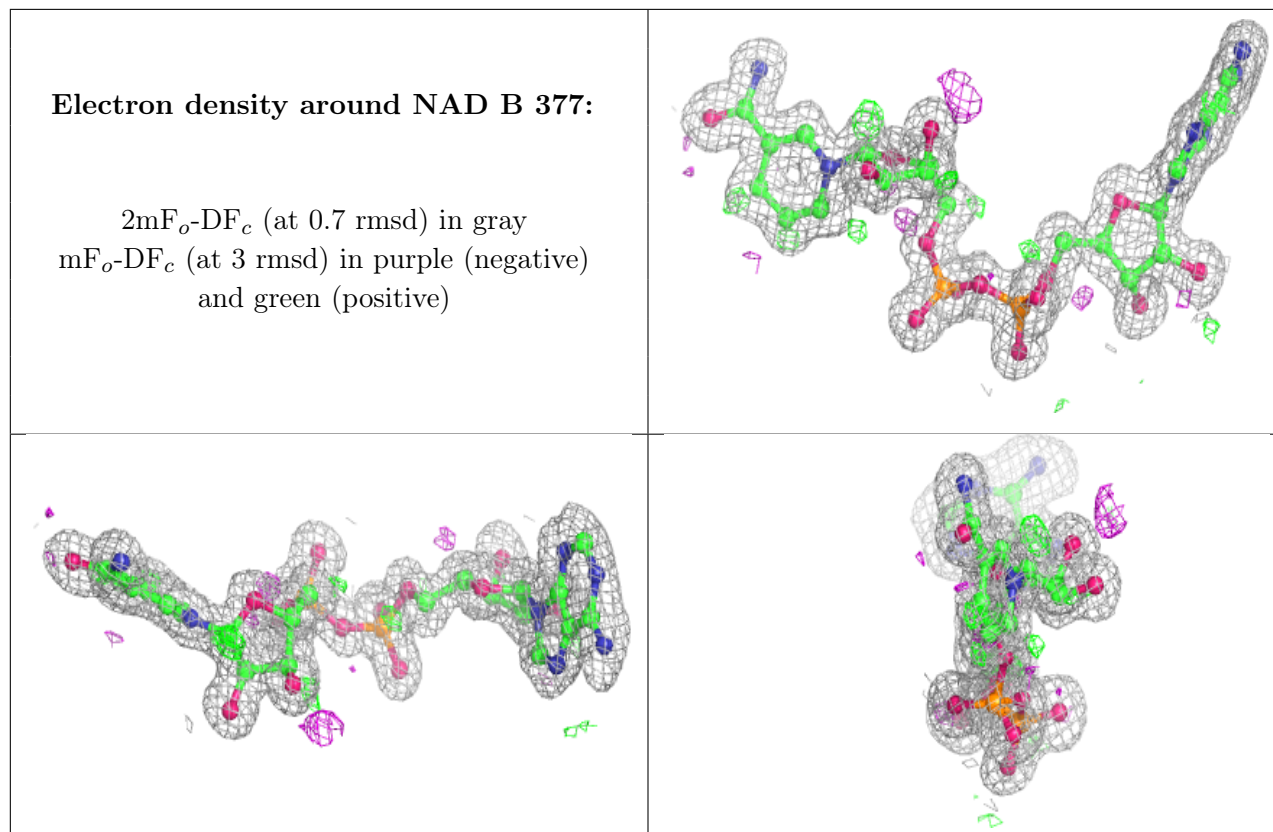
6.4 Ligands [i](#)

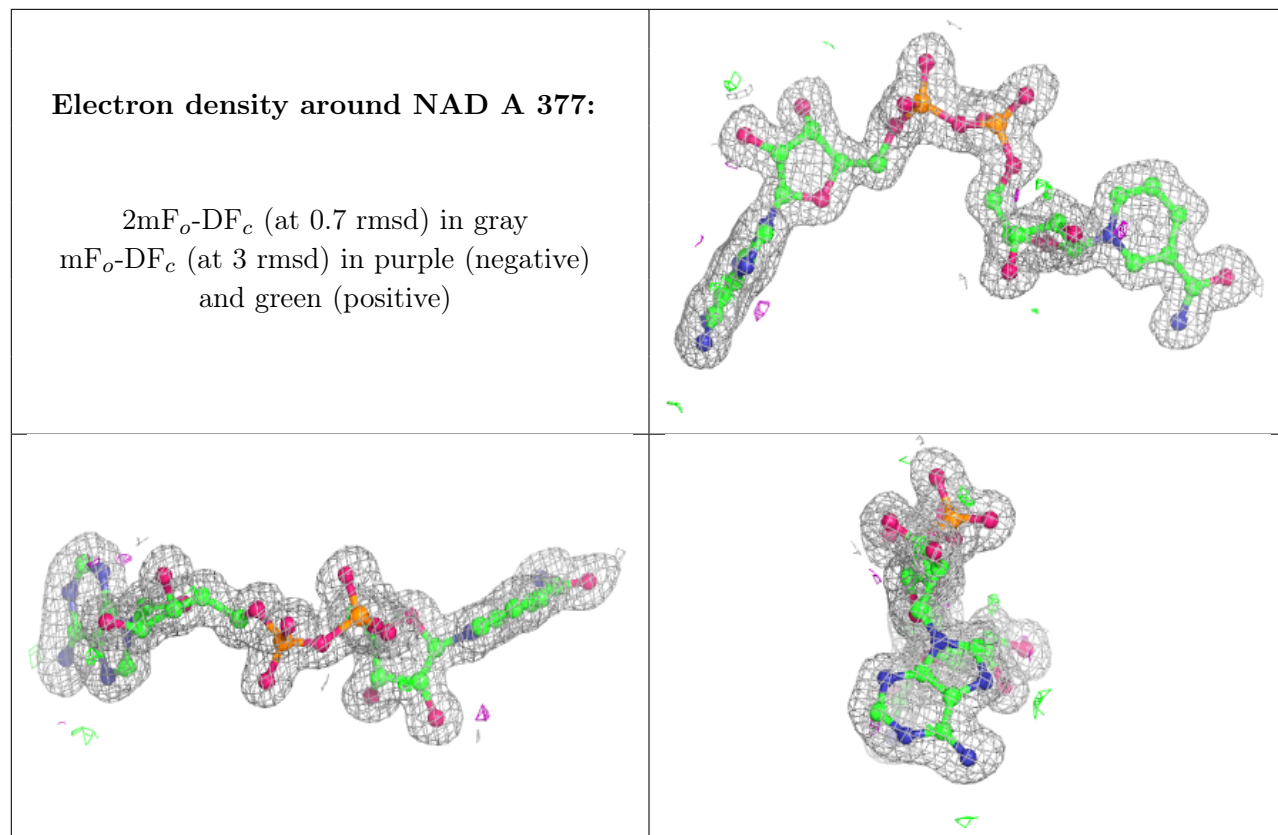
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum,

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(Å ²)	Q<0.9
4	PFB	B	600	13/13	0.67	0.23	25,29,36,38	13
5	MPD	B	602	8/8	0.71	0.17	25,26,27,29	0
4	PFB	B	601	13/13	0.76	0.27	30,33,37,37	13
3	NAD	B	377	44/44	0.97	0.07	12,14,19,23	0
3	NAD	A	377	44/44	0.97	0.06	13,16,23,25	0
2	ZN	A	376	1/1	1.00	0.03	18,18,18,18	0
2	ZN	B	375	1/1	1.00	0.03	16,16,16,16	0
2	ZN	B	376	1/1	1.00	0.03	15,15,15,15	0
2	ZN	A	375	1/1	1.00	0.03	19,19,19,19	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.





6.5 Other polymers [i](#)

There are no such residues in this entry.