



wwPDB X-ray Structure Validation Summary Report i

Apr 17, 2014 – 06:01 PM EDT

PDB ID : 3D9D
Title : Nitroalkane oxidase: mutant D402N crystallized with 1-nitrohexane
Authors : Heroux, A.; Bozinovski, D.M.; Valley, M.P.; Fitzpatrick, P.F.; Orville, A.M.
Deposited on : 2008-05-27
Resolution : 2.10 Å(reported)

This is a wwPDB validation summary 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/ValidationPDFNotes.html>

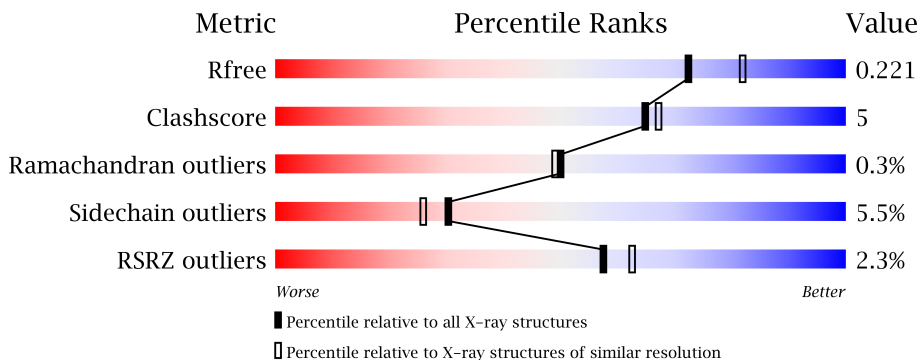
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.16 November 2013
Xtriage (Phenix)	:	dev-1439
EDS	:	stable22978
Percentile statistics	:	21963
Refmac	:	5.8.0049
CCP4	:	6.3.0 (Settle)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP)	:	stable22978

1 Overall quality at a glance





The reported resolution of this entry is 2.10 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}	66092	3012 (2.10-2.10)
Clashscore	79885	3649 (2.10-2.10)
Ramachandran outliers	78287	3610 (2.10-2.10)
Sidechain outliers	78261	3611 (2.10-2.10)
RSRZ outliers	66119	3013 (2.10-2.10)

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. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	438	
1	B	438	
1	C	438	
1	D	438	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
3	N6C	A	600	-	X
3	N6C	B	600	-	X
3	N6C	C	600	-	X
3	N6C	D	600	-	X

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Mol	Type	Chain	Res	Geometry	Electron density
4	GOL	A	701	-	X
4	GOL	B	701	-	X
4	GOL	C	701	-	X
4	GOL	D	700	-	X
4	GOL	D	701	-	X

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 14165 atoms, of which 0 are hydrogen and 0 are deuterium.

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.

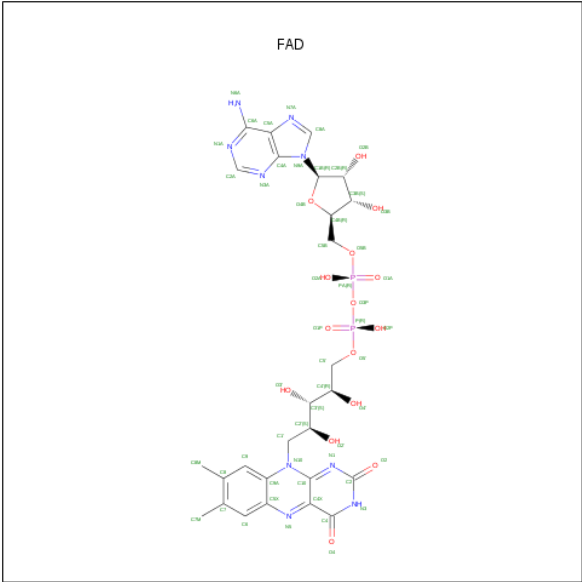
- Molecule 1 is a protein called Nitroalkane oxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	432	Total	C	N	O	S	0	0	0
			3312	2098	567	627	20			
1	B	431	Total	C	N	O	S	0	0	0
			3300	2092	565	623	20			
1	C	430	Total	C	N	O	S	0	0	0
			3301	2092	565	624	20			
1	D	431	Total	C	N	O	S	0	0	0
			3306	2095	566	625	20			

There are 4 discrepancies between the modelled and reference sequences:

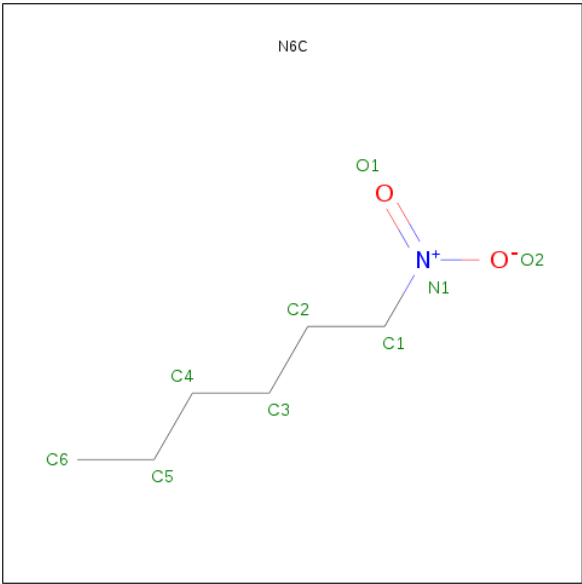
Chain	Residue	Modelled	Actual	Comment	Reference
A	402	ASN	ASP	ENGINEERED	UNP Q8X1D8
B	402	ASN	ASP	ENGINEERED	UNP Q8X1D8
C	402	ASN	ASP	ENGINEERED	UNP Q8X1D8
D	402	ASN	ASP	ENGINEERED	UNP Q8X1D8

- Molecule 2 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula: $C_{27}H_{33}N_9O_{15}P_2$).



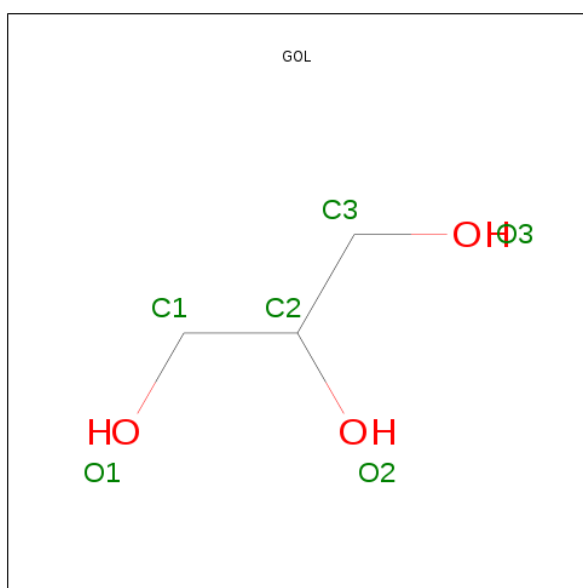
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	B	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	C	1	Total	C	N	O	P	0	0
			53	27	9	15	2		
2	D	1	Total	C	N	O	P	0	0
			53	27	9	15	2		

- Molecule 3 is 1-NITROHEXANE (three-letter code: N6C) (formula: C₆H₁₃NO₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			9	6	1	2		
3	B	1	Total	C	N	O	0	0
			9	6	1	2		
3	C	1	Total	C	N	O	0	0
			9	6	1	2		
3	D	1	Total	C	N	O	0	0
			9	6	1	2		

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			6	3	3		
4	A	1	Total	C	O	0	0
			6	3	3		
4	B	1	Total	C	O	0	0
			6	3	3		
4	B	1	Total	C	O	0	0
			6	3	3		
4	C	1	Total	C	O	0	0
			6	3	3		
4	C	1	Total	C	O	0	0
			6	3	3		
4	D	1	Total	C	O	0	0
			6	3	3		
4	D	1	Total	C	O	0	0
			6	3	3		

- Molecule 5 is water.

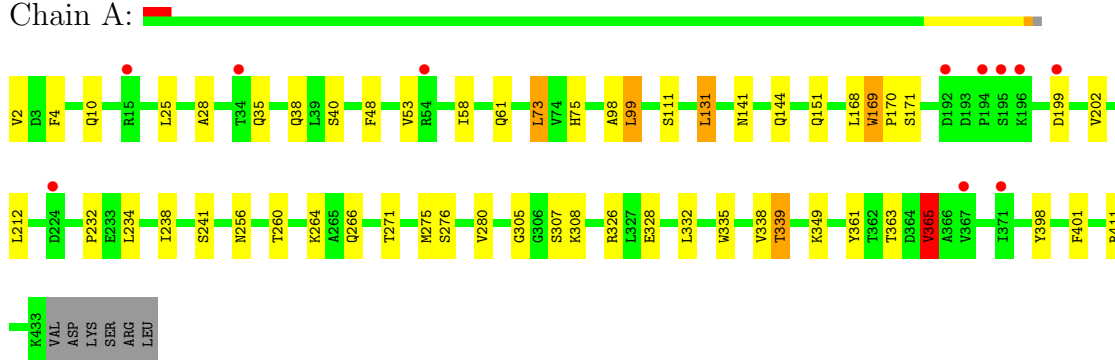
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	160	Total 160	O 160	0	0
5	B	150	Total 150	O 150	0	0
5	C	167	Total 167	O 167	0	0
5	D	173	Total 173	O 173	0	0

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 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.

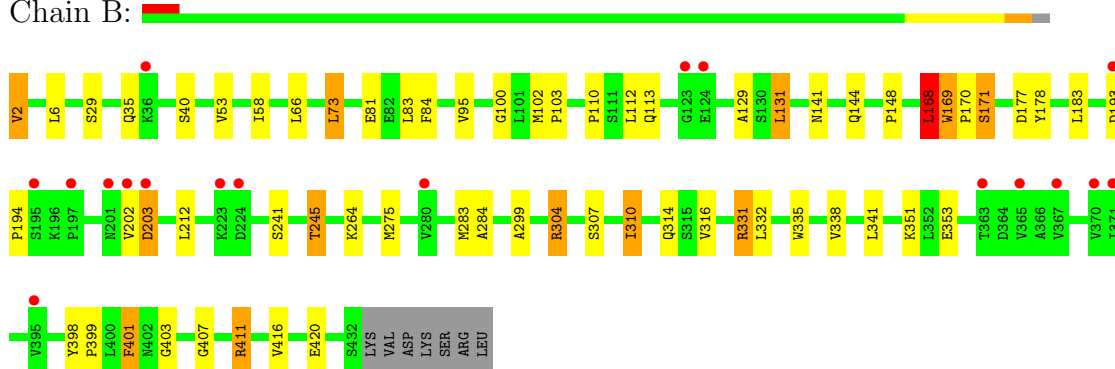
- Molecule 1: Nitroalkane oxidase

Chain A:



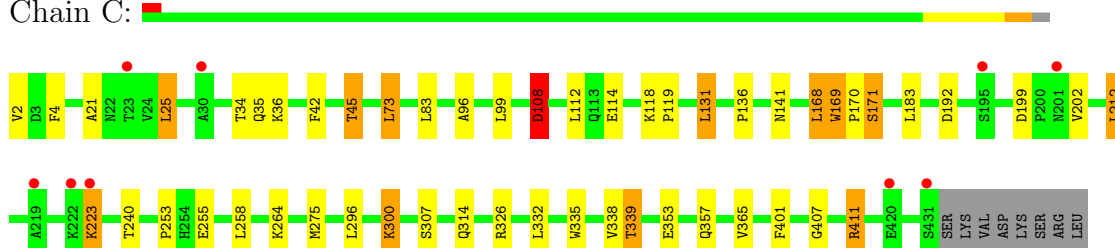
- Molecule 1: Nitroalkane oxidase

Chain B:



- Molecule 1: Nitroalkane oxidase

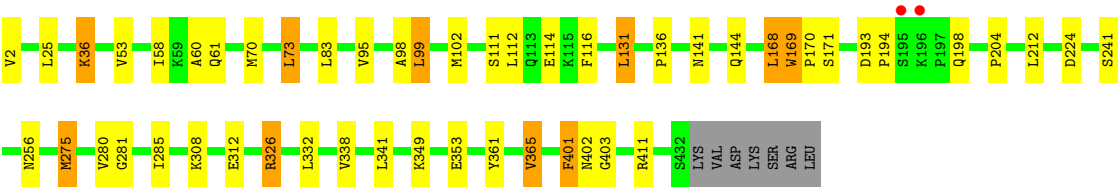
Chain C:



- Molecule 1: Nitroalkane oxidase

Chain D:





4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	107.88Å 107.88Å 338.44Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.10 48.66 – 2.10	Depositor EDS
% Data completeness (in resolution range)	91.9 (50.00-2.10) 91.8 (48.66-2.10)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.09	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.39 (at 2.10Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.180 , 0.219 0.185 , 0.221	Depositor DCC
R_{free} test set	6169 reflections (5.28%)	DCC
Wilson B-factor (Å ²)	32.1	Xtriage
Anisotropy	0.004	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.41 , 48.4	EDS
Estimated twinning fraction	0.033 for -h,-k,l	Xtriage
L-test for twinning	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.30$	Xtriage
Outliers	0 of 123030 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	14165	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.86% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality ⓘ

5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, N6C, FAD

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	0.68	0/3381	0.71	1/4589 (0.0%)
1	B	0.67	0/3369	0.76	4/4575 (0.1%)
1	C	0.69	0/3370	0.73	2/4574 (0.0%)
1	D	0.69	0/3375	0.72	1/4581 (0.0%)
All	All	0.68	0/13495	0.73	8/18319 (0.0%)

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	C	1	0

There are no bond length outliers.

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	331	ARG	NE-CZ-NH2	-11.50	114.55	120.30
1	B	331	ARG	NE-CZ-NH1	8.58	124.59	120.30
1	A	365	VAL	CG1-CB-CG2	5.79	120.16	110.90
1	B	168	LEU	CA-CB-CG	5.59	128.15	115.30
1	D	326	ARG	NE-CZ-NH1	-5.59	117.51	120.30

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	C	108	ASP	CA

There are no planarity outliers.

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	3312	0	3317	35	0
1	B	3300	0	3295	46	0
1	C	3301	0	3310	37	2
1	D	3306	0	3312	31	0
2	A	53	0	31	3	0
2	B	53	0	31	2	0
2	C	53	0	31	3	0
2	D	53	0	31	2	0
3	A	9	0	13	2	0
3	B	9	0	13	7	0
3	C	9	0	13	0	0
3	D	9	0	13	2	0
4	A	12	0	16	1	0
4	B	12	0	16	1	0
4	C	12	0	16	2	0
4	D	12	0	16	1	0
5	A	160	0	0	2	0
5	B	150	0	0	2	0
5	C	167	0	0	4	1
5	D	173	0	0	1	0
All	All	14165	0	13474	143	2

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 5.

The worst 5 of 143 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:203:ASP:HB3	5:B:785:HOH:O	1.40	1.19
1:B:102:MET:HE1	1:B:275:MET:HG3	1.36	1.06
1:B:245:THR:HG23	5:B:851:HOH:O	1.74	0.88
1:A:141:ASN:HD21	2:A:500:FAD:H61A	1.20	0.86
1:D:275:MET:HE3	1:D:341:LEU:HD13	1.58	0.83

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:C:114:GLU:OE1	5:C:840:HOH:O[6_554]	1.71	0.49
1:C:108:ASP:OD2	1:C:264:LYS:NZ[6_554]	2.11	0.09

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	430/438 (98%)	424 (99%)	5 (1%)	1 (0%)	56	57
1	B	429/438 (98%)	419 (98%)	8 (2%)	2 (0%)	38	33
1	C	428/438 (98%)	418 (98%)	9 (2%)	1 (0%)	56	57
1	D	429/438 (98%)	422 (98%)	5 (1%)	2 (0%)	38	33
All	All	1716/1752 (98%)	1683 (98%)	27 (2%)	6 (0%)	50	49

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	169	TRP
1	B	169	TRP
1	C	169	TRP
1	D	169	TRP
1	D	403	GLY

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	355/363 (98%)	338 (95%)	17 (5%)	35	32
1	B	351/363 (97%)	331 (94%)	20 (6%)	29	24
1	C	354/363 (98%)	335 (95%)	19 (5%)	31	27

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	354/363 (98%)	332 (94%)	22 (6%)	26	21
All	All	1414/1452 (97%)	1336 (94%)	78 (6%)	30	26

5 of 78 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	411	ARG
1	C	108	ASP
1	D	332	LEU
1	B	420	GLU
1	C	45	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 38 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	207	GLN
1	C	18	GLN
1	D	198	GLN
1	B	266	GLN
1	C	22	ASN

5.3.3 RNA ⓘ

There are no RNA chains 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 ⓘ

16 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	FAD	A	500	-	58,58,58	1.15	4 (6%)	85,89,89	1.97	11 (12%)
3	N6C	A	600	-	8,8,8	0.33	0	8,8,8	1.34	1 (12%)
4	GOL	A	700	-	5,5,5	0.36	0	5,5,5	0.58	0
4	GOL	A	701	-	5,5,5	0.41	0	5,5,5	0.74	0
2	FAD	B	500	-	58,58,58	1.17	7 (12%)	85,89,89	1.90	16 (18%)
3	N6C	B	600	-	8,8,8	0.40	0	8,8,8	1.05	1 (12%)
4	GOL	B	700	-	5,5,5	0.35	0	5,5,5	0.41	0
4	GOL	B	701	-	5,5,5	0.34	0	5,5,5	0.35	0
2	FAD	C	500	-	58,58,58	1.16	5 (8%)	85,89,89	1.88	13 (15%)
3	N6C	C	600	-	8,8,8	0.44	0	8,8,8	1.28	1 (12%)
4	GOL	C	700	-	5,5,5	0.42	0	5,5,5	0.51	0
4	GOL	C	701	-	5,5,5	0.43	0	5,5,5	0.35	0
2	FAD	D	500	-	58,58,58	1.18	6 (10%)	85,89,89	1.98	16 (18%)
3	N6C	D	600	-	8,8,8	0.35	0	8,8,8	1.13	1 (12%)
4	GOL	D	700	-	5,5,5	0.53	0	5,5,5	0.52	0
4	GOL	D	701	-	5,5,5	0.37	0	5,5,5	0.55	0

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	FAD	A	500	-	-	0/34/50/50	0/6/6/6
3	N6C	A	600	-	-	0/6/6/6	0/0/0/0
4	GOL	A	700	-	-	0/4/4/4	0/0/0/0
4	GOL	A	701	-	-	0/4/4/4	0/0/0/0
2	FAD	B	500	-	-	0/34/50/50	0/6/6/6
3	N6C	B	600	-	-	0/6/6/6	0/0/0/0
4	GOL	B	700	-	-	0/4/4/4	0/0/0/0
4	GOL	B	701	-	-	0/4/4/4	0/0/0/0
2	FAD	C	500	-	-	0/34/50/50	0/6/6/6
3	N6C	C	600	-	-	1/6/6/6	0/0/0/0
4	GOL	C	700	-	-	0/4/4/4	0/0/0/0
4	GOL	C	701	-	-	0/4/4/4	0/0/0/0

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	FAD	D	500	-	-	0/34/50/50	0/6/6/6
3	N6C	D	600	-	-	0/6/6/6	0/0/0/0
4	GOL	D	700	-	-	0/4/4/4	0/0/0/0
4	GOL	D	701	-	-	0/4/4/4	0/0/0/0

The worst 5 of 22 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	500	FAD	C4X-N5	4.17	1.40	1.33
2	A	500	FAD	C2A-N3A	3.88	1.39	1.32
2	D	500	FAD	C2A-N3A	3.87	1.39	1.32
2	A	500	FAD	C4X-N5	3.74	1.39	1.33
2	C	500	FAD	C2A-N3A	3.58	1.38	1.32

The worst 5 of 60 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	500	FAD	N3A-C2A-N1A	-10.99	119.22	128.89
2	A	500	FAD	N3A-C2A-N1A	-10.64	119.53	128.89
2	C	500	FAD	N3A-C2A-N1A	-9.85	120.23	128.89
2	B	500	FAD	N3A-C2A-N1A	-8.88	121.08	128.89
2	B	500	FAD	C5A-C4A-N3A	-6.65	119.50	125.98

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	600	N6C	C2-C1-N1-O2

There are no ring outliers.

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues

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	432/438 (98%)	0.09	11 (2%) 54 59	25, 36, 51, 63	1 (0%)
1	B	431/438 (98%)	0.10	18 (4%) 35 39	25, 37, 51, 61	1 (0%)
1	C	430/438 (98%)	-0.06	9 (2%) 60 65	24, 33, 49, 66	1 (0%)
1	D	431/438 (98%)	-0.21	2 (0%) 88 91	25, 33, 47, 57	2 (0%)
All	All	1724/1752 (98%)	-0.02	40 (2%) 57 62	24, 35, 49, 66	5 (0%)

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	195	SER	4.4
1	C	30	ALA	3.9
1	C	431	SER	3.8
1	A	196	LYS	3.7
1	C	195	SER	3.6

6.2 Non-standard residues in protein, DNA, RNA chains

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates

There are no carbohydrates in this entry.

6.4 Ligands

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	RSR	LLDF	B-factors(\AA^2)	Q<0.9
3	N6C	C	600	9/9	0.23	4.59	46,48,53,55	0
3	N6C	A	600	9/9	0.24	4.34	48,50,51,52	0
3	N6C	D	600	9/9	0.19	3.95	43,44,45,46	0
3	N6C	B	600	9/9	0.29	3.92	53,55,56,58	0
4	GOL	B	701	6/6	0.15	2.95	56,58,58,58	0
4	GOL	A	701	6/6	0.19	2.91	52,54,55,57	0
4	GOL	D	701	6/6	0.17	2.11	53,54,55,56	0
4	GOL	D	700	6/6	0.10	2.09	29,31,32,33	0
4	GOL	C	701	6/6	0.14	2.01	48,54,55,56	0
4	GOL	B	700	6/6	0.14	1.35	35,38,38,39	0
4	GOL	A	700	6/6	0.11	1.31	35,37,37,38	0
2	FAD	C	500	53/53	0.10	-0.29	23,28,31,33	0
2	FAD	B	500	53/53	0.11	-0.36	27,31,34,38	0
2	FAD	D	500	53/53	0.09	-0.50	23,27,31,32	0
2	FAD	A	500	53/53	0.09	-0.87	25,30,34,36	0
4	GOL	C	700	6/6	0.09	-1.02	29,32,33,35	0

6.5 Other polymers ⓘ

There are no such residues in this entry.