



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2018 – 05:27 pm GMT

PDB ID : 3D9G  
Title : Nitroalkane oxidase: wild type crystallized in a trapped state forming a cyanoadduct with FAD  
Authors : Heroux, A.; Bozinovski, D.M.; Valley, M.P.; Fitzpatrick, P.F.; Orville, A.M.  
Deposited on : 2008-05-27  
Resolution : 2.15 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto: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.

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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)  
Xtriage (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

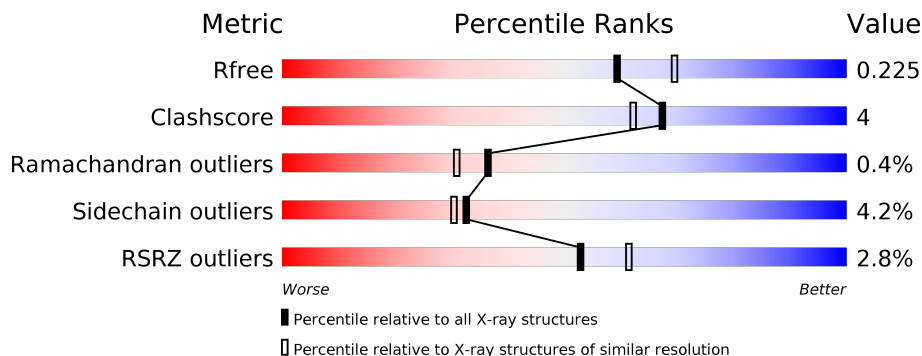
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.15 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	1287 (2.16-2.16)
Clashscore	122126	1390 (2.16-2.16)
Ramachandran outliers	120053	1368 (2.16-2.16)
Sidechain outliers	120020	1367 (2.16-2.16)
RSRZ outliers	108989	1262 (2.16-2.16)

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  $\geq 3$ , 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	438	<div> <div>6%</div> <div> <div></div> <div>86%</div> <div>11%</div> <div>..</div> </div> </div>
1	B	438	<div> <div>3%</div> <div> <div></div> <div>89%</div> <div>8%</div> <div>..</div> </div> </div>
1	C	438	<div> <div>2%</div> <div> <div></div> <div>90%</div> <div>7%</div> <div>..</div> </div> </div>
1	D	438	<div> <div></div> <div> <div></div> <div>86%</div> <div>10%</div> <div>..</div> </div> </div>

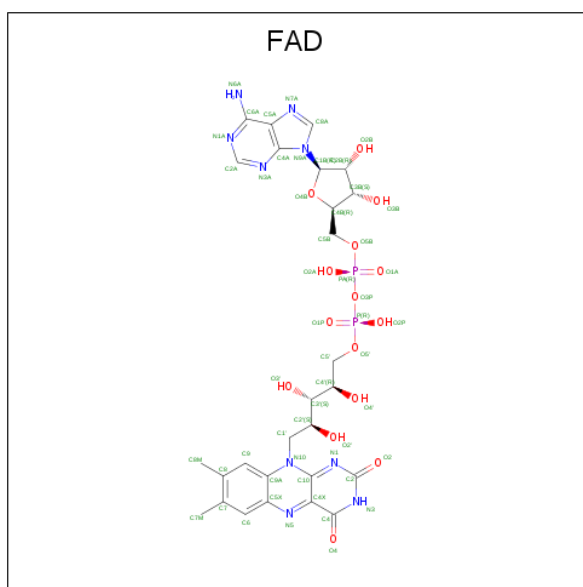


In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Nitroalkane oxidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	430	Total 3315	C 2100	N 568	O 626	S 21	0	1	0
1	B	431	Total 3320	C 2103	N 569	O 627	S 21	0	1	0
1	C	430	Total 3307	C 2095	N 567	O 625	S 20	0	0	0
1	D	430	Total 3315	C 2100	N 568	O 626	S 21	0	1	0

- Molecule 2 is FLAVIN-ADENINE DINUCLEOTIDE (three-letter code: FAD) (formula:  $\text{C}_{27}\text{H}_{33}\text{N}_9\text{O}_{15}\text{P}_2$ ).



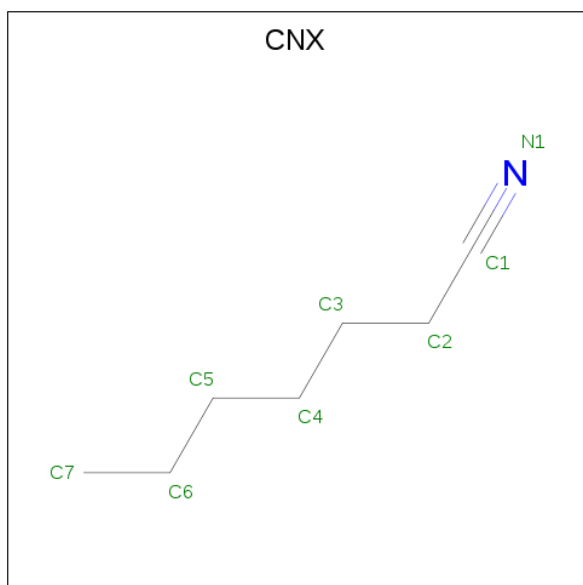
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total 53	C 27	N 9	O 15	P 2	0	0
2	B	1	Total 53	C 27	N 9	O 15	P 2	0	0

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
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 heptanenitrile (three-letter code: CNX) (formula:  $C_7H_{13}N$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	N	0	0
			8	7	1		
3	B	1	Total	C	N	0	0
			8	7	1		
3	C	1	Total	C	N	0	0
			8	7	1		
3	D	1	Total	C	N	0	0
			8	7	1		

- 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	D	1	Total	C	O	0	0
			6	3	3		

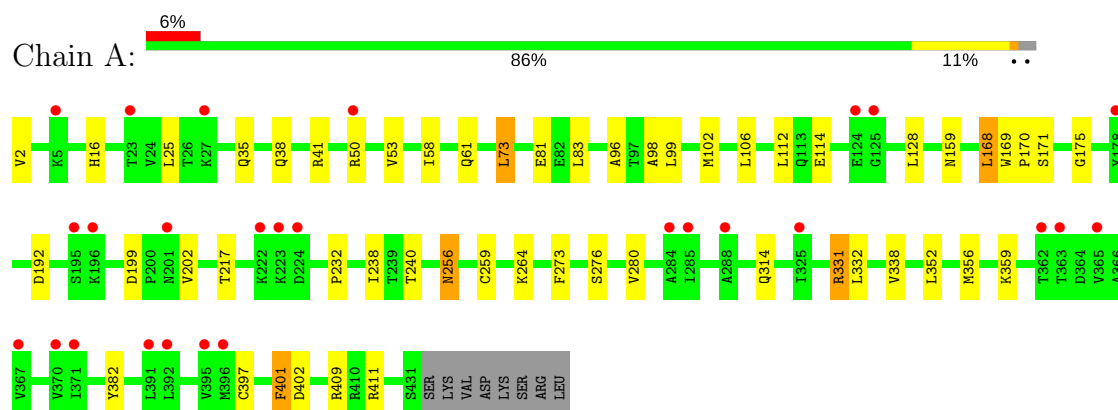
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	204	Total	O	0	0
			204	204		
5	B	194	Total	O	0	0
			194	194		
5	C	219	Total	O	0	0
			219	219		
5	D	223	Total	O	0	0
			223	223		

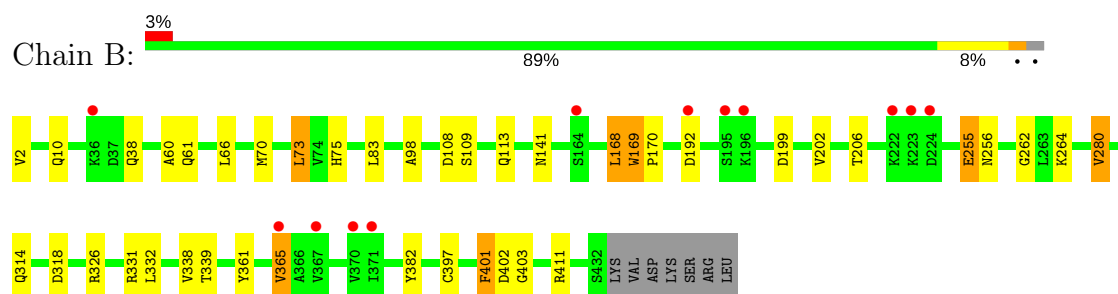
### 3 Residue-property plots [i](#)

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.

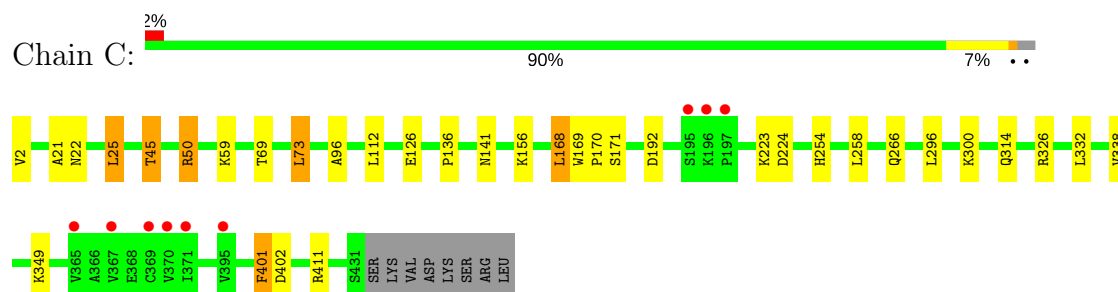
#### • Molecule 1: Nitroalkane oxidase



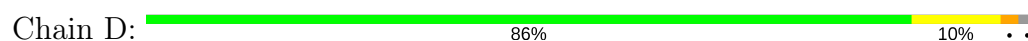
#### • Molecule 1: Nitroalkane oxidase

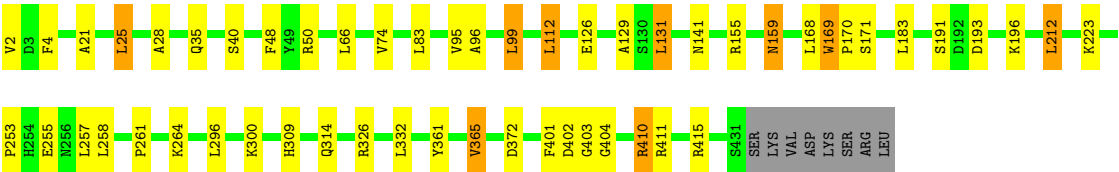


#### • Molecule 1: Nitroalkane oxidase



#### • Molecule 1: Nitroalkane oxidase





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	109.26Å 109.26Å 343.94Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.15 49.32 – 2.15	Depositor EDS
% Data completeness (in resolution range)	94.0 (50.00-2.15) 94.0 (49.32-2.15)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	0.10	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.98 (at 2.16Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.194 , 0.233 0.191 , 0.225	Depositor DCC
$R_{free}$ test set	6137 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	37.0	Xtriage
Anisotropy	0.061	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 31.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	0.011 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	14353	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.80% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: GOL, FAD, CNX

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	0.50	0/3384	0.61	1/4592 (0.0%)
1	B	0.50	0/3389	0.62	2/4599 (0.0%)
1	C	0.52	0/3376	0.59	0/4581
1	D	0.51	0/3384	0.63	2/4592 (0.0%)
All	All	0.51	0/13533	0.61	5/18364 (0.0%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	331	ARG	NE-CZ-NH2	-8.92	115.84	120.30
1	A	331	ARG	NE-CZ-NH2	-6.78	116.91	120.30
1	D	410	ARG	NE-CZ-NH1	6.02	123.31	120.30
1	D	410	ARG	NE-CZ-NH2	-5.85	117.37	120.30
1	B	331	ARG	NE-CZ-NH1	5.83	123.22	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	3315	0	3328	30	0
1	B	3320	0	3330	30	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	3307	0	3319	23	0
1	D	3315	0	3328	32	0
2	A	53	0	31	3	0
2	B	53	0	31	1	0
2	C	53	0	31	5	0
2	D	53	0	31	3	0
3	A	8	0	12	3	0
3	B	8	0	12	4	0
3	C	8	0	12	4	0
3	D	8	0	12	3	0
4	A	6	0	8	1	0
4	D	6	0	8	2	0
5	A	204	0	0	1	0
5	B	194	0	0	3	0
5	C	219	0	0	5	0
5	D	223	0	0	3	0
All	All	14353	0	13493	114	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.

The worst 5 of 114 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:D:159:ASN:HD22	1:D:159:ASN:H	1.21	0.83
1:C:141:ASN:HD21	2:C:500:FAD:H61A	1.24	0.82
1:C:22:ASN:HB3	5:C:697:HOH:O	1.78	0.81
1:B:199:ASP:HB3	1:B:202:VAL:HG12	1.64	0.79
1:B:199:ASP:HB3	1:B:202:VAL:CG1	2.16	0.76

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	429/438 (98%)	423 (99%)	5 (1%)	1 (0%)	49	48
1	B	430/438 (98%)	422 (98%)	6 (1%)	2 (0%)	31	24
1	C	428/438 (98%)	420 (98%)	7 (2%)	1 (0%)	49	48
1	D	429/438 (98%)	419 (98%)	8 (2%)	2 (0%)	31	24
All	All	1716/1752 (98%)	1684 (98%)	26 (2%)	6 (0%)	36	39

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	356/363 (98%)	339 (95%)	17 (5%)	28	24
1	B	356/363 (98%)	344 (97%)	12 (3%)	40	38
1	C	355/363 (98%)	341 (96%)	14 (4%)	35	33
1	D	356/363 (98%)	340 (96%)	16 (4%)	30	26
All	All	1423/1452 (98%)	1364 (96%)	59 (4%)	32	31

5 of 59 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	365	VAL
1	C	73	LEU
1	D	264	LYS

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Mol	Chain	Res	Type
1	B	401	PHE
1	C	2	VAL

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 40 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	266	GLN
1	C	113	GLN
1	D	159	ASN
1	C	22	ASN
1	C	137	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](#)

10 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	3	51,58,58	1.46	3 (5%)	57,89,89	1.92	8 (14%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
3	CNX	A	501	2	7,7,7	0.34	0	6,6,6	0.97	0
4	GOL	A	700	-	5,5,5	0.44	0	5,5,5	0.18	0
2	FAD	B	500	3	51,58,58	1.57	4 (7%)	57,89,89	2.07	9 (15%)
3	CNX	B	501	2	7,7,7	0.44	0	6,6,6	1.30	1 (16%)
2	FAD	C	500	3	51,58,58	1.50	4 (7%)	57,89,89	1.90	7 (12%)
3	CNX	C	501	2	7,7,7	0.49	0	6,6,6	1.34	1 (16%)
2	FAD	D	500	3	51,58,58	1.52	4 (7%)	57,89,89	1.91	7 (12%)
3	CNX	D	501	2	7,7,7	0.72	0	6,6,6	1.52	1 (16%)
4	GOL	D	701	-	5,5,5	0.34	0	5,5,5	0.27	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	3	-	0/28/50/50	0/6/6/6
3	CNX	A	501	2	-	0/5/5/5	0/0/0/0
4	GOL	A	700	-	-	0/4/4/4	0/0/0/0
2	FAD	B	500	3	-	0/28/50/50	0/6/6/6
3	CNX	B	501	2	-	0/5/5/5	0/0/0/0
2	FAD	C	500	3	-	0/28/50/50	0/6/6/6
3	CNX	C	501	2	-	0/5/5/5	0/0/0/0
2	FAD	D	500	3	-	0/28/50/50	0/6/6/6
3	CNX	D	501	2	-	0/5/5/5	0/0/0/0
4	GOL	D	701	-	-	0/4/4/4	0/0/0/0

The worst 5 of 15 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	500	FAD	C2-N3	-2.11	1.34	1.38
2	D	500	FAD	O4B-C1B	2.56	1.44	1.41
2	B	500	FAD	C9A-N10	2.60	1.41	1.38
2	D	500	FAD	C9A-N10	2.83	1.42	1.38
2	B	500	FAD	O4B-C1B	3.35	1.45	1.41

The worst 5 of 34 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	500	FAD	N3A-C2A-N1A	-10.16	120.17	128.86
2	A	500	FAD	N3A-C2A-N1A	-9.77	120.50	128.86

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	500	FAD	N3A-C2A-N1A	-9.67	120.58	128.86
2	C	500	FAD	N3A-C2A-N1A	-9.01	121.15	128.86
2	C	500	FAD	C9A-N10-C10	-3.55	117.03	121.77

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

10 monomers are involved in 25 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	500	FAD	3	0
3	A	501	CNX	3	0
4	A	700	GOL	1	0
2	B	500	FAD	1	0
3	B	501	CNX	4	0
2	C	500	FAD	5	0
3	C	501	CNX	4	0
2	D	500	FAD	3	0
3	D	501	CNX	3	0
4	D	701	GOL	2	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 [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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	430/438 (98%)	0.25	27 (6%) 20 26	27, 40, 52, 61	0
1	B	431/438 (98%)	0.06	12 (2%) 53 61	26, 37, 50, 58	0
1	C	430/438 (98%)	-0.08	9 (2%) 63 70	27, 35, 48, 59	0
1	D	430/438 (98%)	-0.09	0 100 100	26, 37, 51, 60	1 (0%)
All	All	1721/1752 (98%)	0.04	48 (2%) 53 61	26, 37, 50, 61	1 (0%)

The worst 5 of 48 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	367	VAL	3.8
1	B	371	ILE	3.4
1	A	395	VAL	3.3
1	A	371	ILE	3.1
1	C	195	SER	3.0

### 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. The B-factors column lists the minimum, median, 95<sup>th</sup> 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( $\text{\AA}^2$ )	Q<0.9
4	GOL	D	701	6/6	0.89	0.22	55,56,57,58	0
3	CNX	A	501	8/8	0.92	0.16	39,41,43,44	0
3	CNX	B	501	8/8	0.94	0.17	36,40,42,44	0
3	CNX	D	501	8/8	0.96	0.15	37,39,40,41	0
3	CNX	C	501	8/8	0.97	0.11	35,39,42,43	0
4	GOL	A	700	6/6	0.97	0.11	41,42,43,43	0
2	FAD	C	500	53/53	0.98	0.09	24,27,32,32	0
2	FAD	D	500	53/53	0.98	0.12	24,31,34,36	0
2	FAD	B	500	53/53	0.98	0.10	26,30,32,32	0
2	FAD	A	500	53/53	0.98	0.09	29,33,36,37	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.