



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2018 – 08:58 pm GMT

PDB ID : 1005  
Title : Studies on the Nitroreductase Prodrug-Activating System. Crystal Structures of the Enzyme Active Form and Complexes with the Inhibitor Dicoumarol and Dinitrobenzamide Prodrugs  
Authors : Johansson, E.; Parkinson, G.N.; Denny, W.A.; Neidle, S.  
Deposited on : 2003-03-03  
Resolution : 2.50 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](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

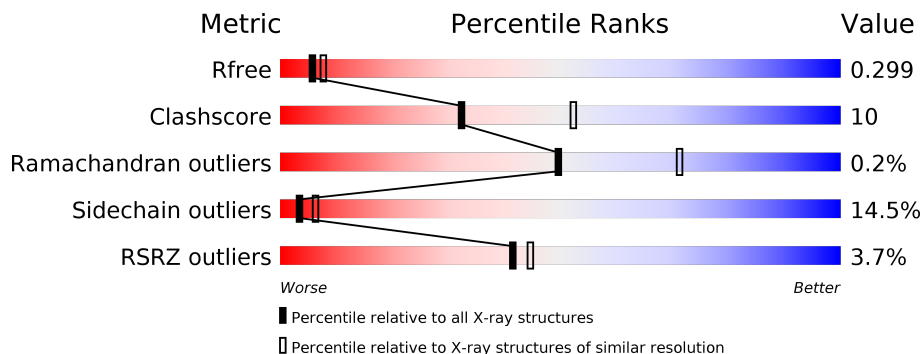
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.50 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	4155 (2.50-2.50)
Clashscore	122126	4827 (2.50-2.50)
Ramachandran outliers	120053	4735 (2.50-2.50)
Sidechain outliers	120020	4737 (2.50-2.50)
RSRZ outliers	108989	4058 (2.50-2.50)

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	217	 5% 74% 23% .
1	B	217	 2% 70% 26% .

## 2 Entry composition [i](#)

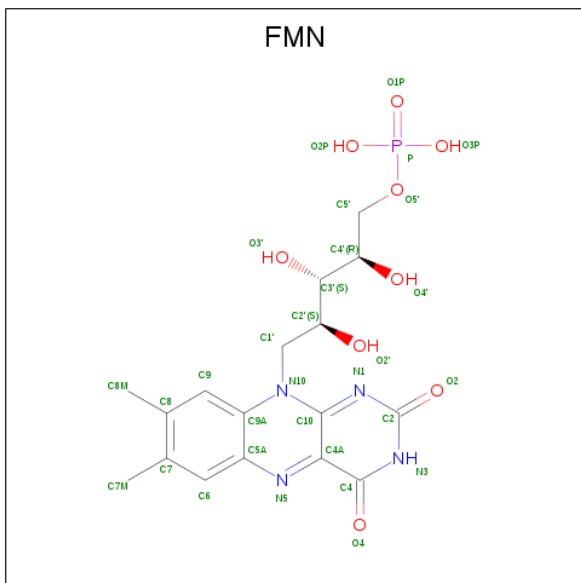
There are 3 unique types of molecules in this entry. The entry contains 3496 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Oxygen-insensitive NAD(P)H nitroreductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	217	Total 1685	C 1070	N 288	O 321	S 6	0	0	0
1	B	217	Total 1685	C 1070	N 288	O 321	S 6	0	0	0

- Molecule 2 is FLAVIN MONONUCLEOTIDE (three-letter code: FMN) (formula: C<sub>17</sub>H<sub>21</sub>N<sub>4</sub>O<sub>9</sub>P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	Total 31	C 17	N 4	O 9	P 1	0	0
2	B	1	Total 31	C 17	N 4	O 9	P 1	0	0

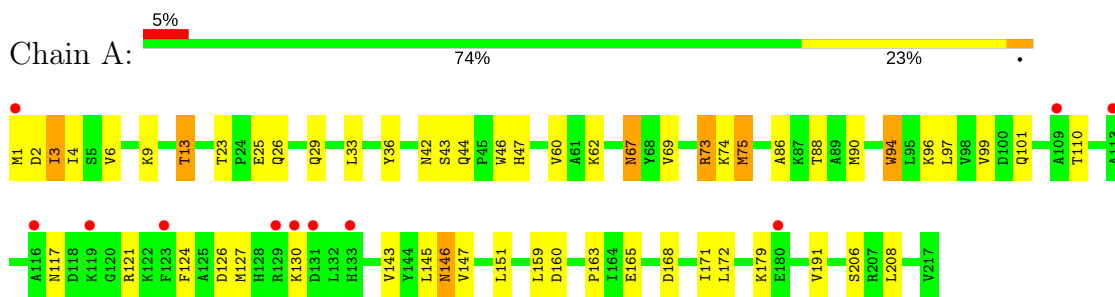
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	36	Total 36	O 36	0	0
3	B	28	Total 28	O 28	0	0

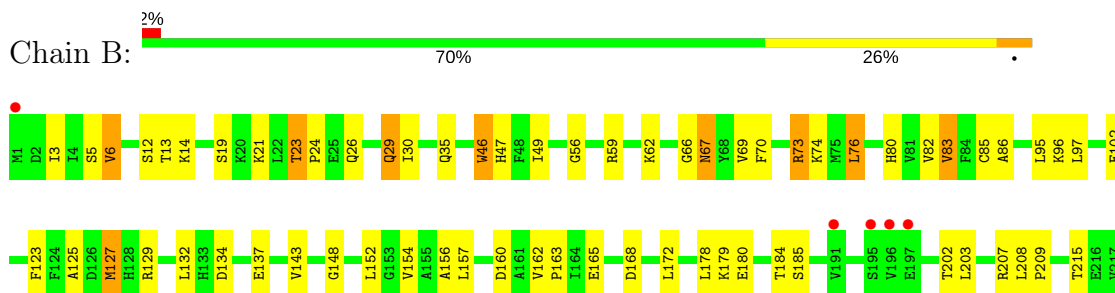
### 3 Residue-property plots [i](#)

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: Oxygen-insensitive NAD(P)H nitroreductase



- Molecule 1: Oxygen-insensitive NAD(P)H nitroreductase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	56.97Å 56.97Å 265.65Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.92 – 2.50 19.91 – 2.50	Depositor EDS
% Data completeness (in resolution range)	73.7 (19.92-2.50) 94.0 (19.91-2.50)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	0.81 (at 2.50Å)	Xtrriage
Refinement program	CNS 1.0	Depositor
R, $R_{free}$	0.204 , 0.289 0.223 , 0.299	Depositor DCC
$R_{free}$ test set	1225 reflections (7.93%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	39.4	Xtrriage
Anisotropy	0.471	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 44.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.28$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	3496	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	37.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.52% 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

### 5.1 Standard geometry

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

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	0.54	0/1720	0.56	0/2328
1	B	0.52	0/1720	0.58	0/2328
All	All	0.53	0/3440	0.57	0/4656

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	1685	0	1673	37	0
1	B	1685	0	1673	42	0
2	A	31	0	19	2	0
2	B	31	0	19	3	0
3	A	36	0	0	1	0
3	B	28	0	0	0	0
All	All	3496	0	3384	65	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 10.

All (65) 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:B:165:GLU:HB2	2:B:219:FMN:H6	1.45	0.96
1:A:13:THR:HG21	1:A:160:ASP:HB3	1.48	0.93
1:A:44:GLN:HE22	1:B:208:LEU:H	1.13	0.91
1:B:23:THR:HG22	1:B:24:PRO:HD2	1.57	0.86
1:A:4:ILE:HG13	1:B:29:GLN:HG2	1.63	0.78
1:A:23:THR:H	1:A:26:GLN:HE21	1.40	0.68
1:A:165:GLU:HB2	2:A:218:FMN:H6	1.78	0.66
1:A:60:VAL:HG12	1:A:75:MET:HE2	1.78	0.66
1:A:67:ASN:HD22	1:B:123:PHE:HZ	1.44	0.65
1:A:23:THR:H	1:A:26:GLN:NE2	1.97	0.61
1:A:73:ARG:HA	1:A:73:ARG:NH2	2.15	0.61
1:B:13:THR:OG1	1:B:160:ASP:HB3	2.00	0.61
1:B:49:ILE:HB	1:B:83:VAL:HG13	1.83	0.61
1:A:3:ILE:HG12	1:B:156:ALA:HB3	1.85	0.59
1:A:163:PRO:HG2	2:A:218:FMN:C9	2.33	0.58
1:A:4:ILE:CG1	1:B:29:GLN:HG2	2.34	0.58
1:A:42:ASN:ND2	2:B:219:FMN:H5'2	2.19	0.58
1:A:86:ALA:HB2	1:A:143:VAL:HG21	1.85	0.58
1:A:168:ASP:OD1	1:A:171:ILE:HG13	2.07	0.55
1:B:86:ALA:HB2	1:B:143:VAL:HG21	1.87	0.55
1:B:3:ILE:HA	1:B:6:VAL:HG13	1.88	0.55
1:B:134:ASP:O	1:B:137:GLU:HG2	2.09	0.53
1:B:49:ILE:HB	1:B:83:VAL:CG1	2.38	0.53
1:B:178:LEU:O	1:B:179:LYS:HB3	2.09	0.52
1:B:67:ASN:N	1:B:67:ASN:ND2	2.58	0.51
1:A:101:GLN:NE2	1:B:209:PRO:HD3	2.27	0.50
1:A:23:THR:HG22	1:A:26:GLN:HB2	1.94	0.49
1:B:178:LEU:C	1:B:180:GLU:H	2.14	0.49
1:B:67:ASN:H	1:B:67:ASN:ND2	2.08	0.49
1:B:70:PHE:H	1:B:70:PHE:HD2	1.61	0.48
1:A:23:THR:HG22	1:A:26:GLN:NE2	2.29	0.47
1:A:23:THR:HG23	1:A:26:GLN:H	1.79	0.47
1:A:25:GLU:O	1:A:29:GLN:HG3	2.15	0.47
1:B:76:LEU:HG	1:B:76:LEU:H	1.53	0.47
1:B:46:TRP:HB3	1:B:143:VAL:HG22	1.96	0.47
1:B:14:LYS:HA	1:B:74:LYS:HE2	1.97	0.46
1:A:3:ILE:HD11	1:B:157:LEU:CD2	2.45	0.46
1:B:26:GLN:HA	1:B:29:GLN:HE21	1.81	0.46
1:B:30:ILE:CD1	1:B:154:VAL:HG12	2.46	0.46
1:A:60:VAL:HG12	1:A:75:MET:CE	2.44	0.46
1:A:2:ASP:O	1:A:6:VAL:HG23	2.16	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:42:ASN:HB2	2:B:219:FMN:O4'	2.17	0.44
1:B:125:ALA:O	1:B:129:ARG:HG2	2.17	0.44
1:A:126:ASP:O	1:A:130:LYS:HB2	2.17	0.44
1:A:4:ILE:HG13	1:B:29:GLN:CG	2.43	0.44
1:A:43:SER:O	1:A:94:TRP:HZ3	2.00	0.44
1:A:67:ASN:ND2	1:B:123:PHE:HZ	2.13	0.44
1:A:36:TYR:HA	1:B:207:ARG:HG3	1.99	0.44
1:B:59:ARG:HH11	1:B:59:ARG:HG3	1.84	0.43
1:B:73:ARG:HA	1:B:76:LEU:HD12	2.00	0.43
3:A:232:HOH:O	1:B:35:GLN:HG3	2.18	0.42
1:B:56:GLY:O	1:B:59:ARG:HB2	2.19	0.42
1:A:99:VAL:HG12	1:A:121:ARG:NH1	2.35	0.42
1:A:206:SER:OG	1:B:102:GLU:HA	2.20	0.41
1:B:127:MET:O	1:B:132:LEU:HG	2.19	0.41
1:B:184:THR:HG22	1:B:185:SER:N	2.35	0.41
1:A:146:ASN:C	1:A:146:ASN:HD22	2.24	0.41
1:B:29:GLN:HB2	1:B:29:GLN:HE21	1.70	0.41
1:B:47:HIS:O	1:B:85:CYS:HB2	2.19	0.41
1:A:143:VAL:O	1:A:147:VAL:HG23	2.20	0.41
1:A:145:LEU:O	1:B:148:GLY:HA3	2.20	0.41
1:A:147:VAL:O	1:A:151:LEU:HG	2.20	0.41
1:B:162:VAL:HA	1:B:163:PRO:HD3	1.89	0.41
1:A:3:ILE:HD11	1:B:157:LEU:HD23	2.02	0.40
1:A:47:HIS:HE1	1:B:215:THR:OG1	2.04	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	215/217 (99%)	207 (96%)	8 (4%)	0	<b>100</b> <b>100</b>

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	215/217 (99%)	204 (95%)	10 (5%)	1 (0%)	31	51
All	All	430/434 (99%)	411 (96%)	18 (4%)	1 (0%)	49	71

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	66	GLY

### 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	179/179 (100%)	152 (85%)	27 (15%)	3	5
1	B	179/179 (100%)	154 (86%)	25 (14%)	4	7
All	All	358/358 (100%)	306 (86%)	52 (14%)	3	6

All (52) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	3	ILE
1	A	9	LYS
1	A	13	THR
1	A	33	LEU
1	A	46	TRP
1	A	62	LYS
1	A	67	ASN
1	A	69	VAL
1	A	73	ARG
1	A	74	LYS
1	A	75	MET
1	A	88	THR
1	A	90	MET
1	A	94	TRP

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Mol	Chain	Res	Type
1	A	96	LYS
1	A	97	LEU
1	A	110	THR
1	A	117	ASN
1	A	124	PHE
1	A	127	MET
1	A	146	ASN
1	A	159	LEU
1	A	172	LEU
1	A	179	LYS
1	A	191	VAL
1	A	208	LEU
1	B	5	SER
1	B	6	VAL
1	B	12	SER
1	B	19	SER
1	B	21	LYS
1	B	23	THR
1	B	29	GLN
1	B	46	TRP
1	B	62	LYS
1	B	67	ASN
1	B	69	VAL
1	B	73	ARG
1	B	76	LEU
1	B	80	HIS
1	B	82	VAL
1	B	83	VAL
1	B	95	LEU
1	B	96	LYS
1	B	97	LEU
1	B	127	MET
1	B	152	LEU
1	B	168	ASP
1	B	172	LEU
1	B	202	THR
1	B	203	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	26	GLN

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Mol	Chain	Res	Type
1	A	42	ASN
1	A	44	GLN
1	A	47	HIS
1	A	101	GLN
1	A	117	ASN
1	A	146	ASN
1	A	210	GLN
1	B	42	ASN
1	B	67	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](#)

2 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	FMN	A	218	-	31,33,33	1.39	6 (19%)	39,50,50	2.44	5 (12%)
2	FMN	B	219	-	31,33,33	1.69	6 (19%)	39,50,50	2.50	6 (15%)

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	FMN	A	218	-	-	0/16/18/18	0/3/3/3
2	FMN	B	219	-	-	0/16/18/18	0/3/3/3

All (12) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	218	FMN	C1'-N10	-2.38	1.45	1.48
2	B	219	FMN	C1'-N10	-2.09	1.46	1.48
2	A	218	FMN	C8-C7	2.01	1.46	1.40
2	A	218	FMN	C6-C5A	2.03	1.45	1.41
2	B	219	FMN	C8-C7	2.21	1.46	1.40
2	A	218	FMN	C4-C4A	2.85	1.46	1.41
2	A	218	FMN	C2-N3	2.88	1.43	1.38
2	B	219	FMN	C6-C5A	3.03	1.46	1.41
2	B	219	FMN	C4-C4A	3.20	1.47	1.41
2	B	219	FMN	C2-N3	3.57	1.45	1.38
2	A	218	FMN	C4A-C10	4.00	1.47	1.41
2	B	219	FMN	C4A-C10	5.09	1.49	1.41

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	219	FMN	C4A-C4-N3	-5.82	115.20	123.47
2	A	218	FMN	C4A-C4-N3	-5.65	115.44	123.47
2	A	218	FMN	C4A-C10-N10	-4.07	116.61	120.40
2	B	219	FMN	C4A-C10-N10	-3.93	116.75	120.40
2	A	218	FMN	C4-C4A-C10	-3.49	117.35	119.95
2	B	219	FMN	C4-C4A-C10	-3.47	117.36	119.95
2	A	218	FMN	C5A-C9A-N10	-2.53	115.79	117.71
2	B	219	FMN	C5A-C9A-N10	-2.52	115.79	117.71
2	B	219	FMN	C6-C5A-C9A	-2.27	115.96	119.01
2	A	218	FMN	C4-N3-C2	11.54	124.96	115.14
2	B	219	FMN	C4-N3-C2	11.89	125.26	115.14

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	218	FMN	2	0
2	B	219	FMN	3	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	217/217 (100%)	0.18	11 (5%) 28 30	12, 31, 61, 65	2 (0%)
1	B	217/217 (100%)	0.20	5 (2%) 60 63	16, 40, 59, 75	3 (1%)
All	All	434/434 (100%)	0.19	16 (3%) 41 44	12, 36, 60, 75	5 (1%)

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1	MET	10.0
1	B	1	MET	7.5
1	A	109	ALA	4.6
1	A	123	PHE	3.8
1	A	130	LYS	3.6
1	A	131	ASP	3.6
1	A	133	HIS	3.5
1	A	113	ALA	3.1
1	A	119	LYS	3.1
1	B	196	VAL	2.8
1	A	116	ALA	2.6
1	A	129	ARG	2.6
1	B	195	SER	2.3
1	B	191	VAL	2.2
1	B	197	GLU	2.2
1	A	180	GLU	2.2

### 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(Å <sup>2</sup> )	Q<0.9
2	FMN	B	219	31/31	0.91	0.17	40,47,48,49	0
2	FMN	A	218	31/31	0.96	0.11	24,31,33,33	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.