



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 04:14 PM UTC

PDB ID : 2QR2 / pdb_00002qr2
Title : HUMAN QUINONE REDUCTASE TYPE 2, COMPLEX WITH MENA-
DIONE
Authors : Foster, C.; Bianchet, M.A.; Talalay, P.; Amzel, L.M.
Deposited on : 1999-04-19
Resolution : 2.45 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 types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

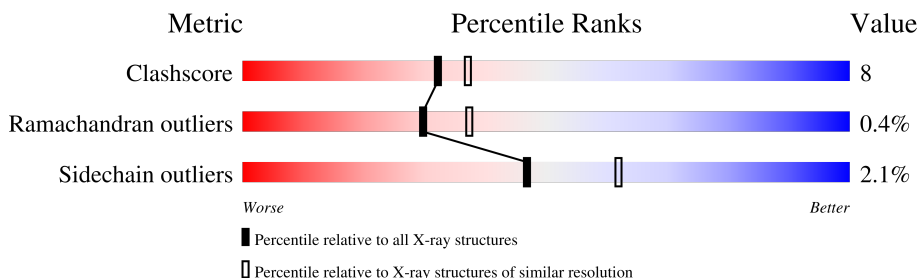
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.45 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))
Clashscore	190562	1229 (2.46-2.46)
Ramachandran outliers	187476	1218 (2.46-2.46)
Sidechain outliers	187428	1218 (2.46-2.46)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	230	 74% 25% .
1	B	230	 82% 17% .

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5013 atoms, of which 1082 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 PROTEIN (QUINONE REDUCTASE TYPE 2).

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	230	Total	C	H	N	O	S	392	0	0
			2216	1174	392	304	338	8			
1	B	230	Total	C	H	N	O	S	392	0	0
			2216	1174	392	304	338	8			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	139	GLY	CYS	SEE REMARK 999	UNP P16083
B	139	GLY	CYS	SEE REMARK 999	UNP P16083

- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

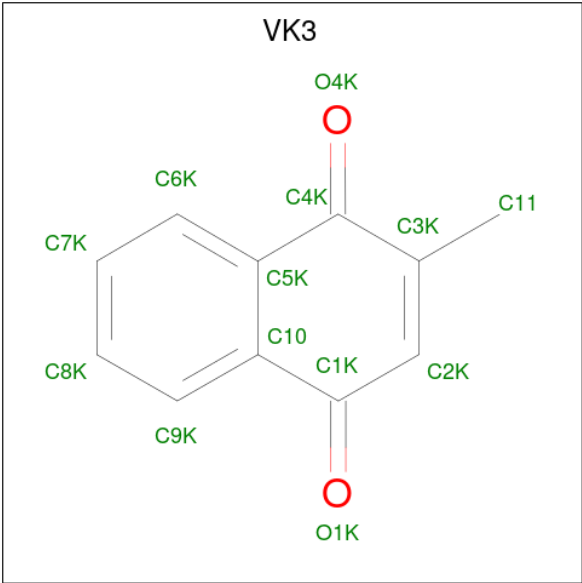
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Zn	0	0
			1	1		
2	B	1	Total	Zn	0	0
			1	1		

- Molecule 3 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula: C₂₇H₃₃N₉O₁₅P₂).



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

- Molecule 4 is MENADIONE (CCD ID: VK3) (formula: C₁₁H₈O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	B	1	Total	C	O	0	0
			13	11	2		
4	B	1	Total	C	O	0	0
			13	11	2		

- Molecule 5 is water.

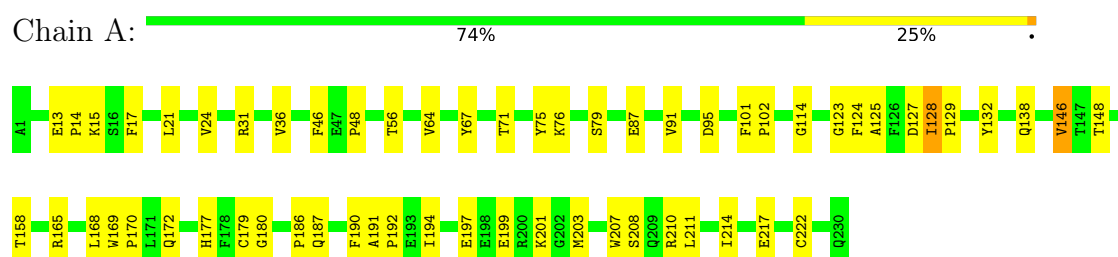
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	67	Total 201	H 134	O 67	134	0
5	B	82	Total 246	H 164	O 82	164	0

3 Residue-property plots [i](#)

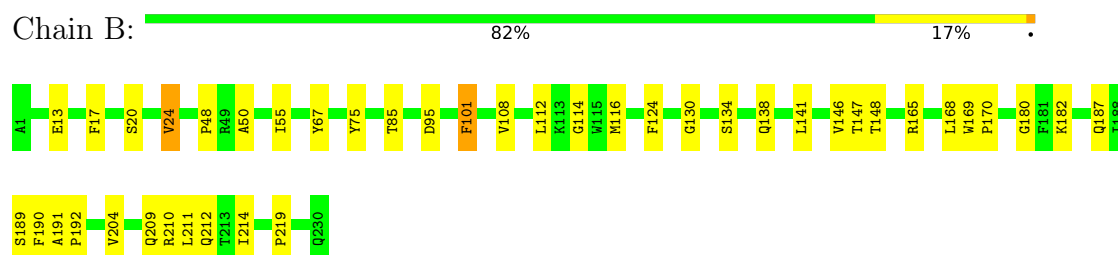
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS was not executed.

• Molecule 1: PROTEIN (QUINONE REDUCTASE TYPE 2)



• Molecule 1: PROTEIN (QUINONE REDUCTASE TYPE 2)



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	83.60 Å 106.27 Å 56.08 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	6.00 – 2.45	Depositor
% Data completeness (in resolution range)	77.4 (6.00-2.45)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
Refinement program	X-PLOR	Depositor
R, R_{free}	0.218 , 0.274	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5013	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

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, VK3, 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	0.37	0/1874	0.86	4/2542 (0.2%)
1	B	0.35	0/1874	0.87	3/2542 (0.1%)
All	All	0.36	0/3748	0.87	7/5084 (0.1%)

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	95	ASP	N-CA-C	-6.56	105.81	113.88
1	A	95	ASP	N-CA-C	-6.14	106.39	114.31
1	A	123	GLY	N-CA-C	-5.92	106.87	113.79
1	B	190	PHE	N-CA-C	5.89	118.88	110.10
1	B	101	PHE	N-CA-C	5.60	115.33	108.11
1	A	36	VAL	N-CA-C	5.39	115.66	108.11
1	A	102	PRO	N-CA-C	-5.07	103.87	111.57

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	1824	392	1779	36	0
1	B	1824	392	1779	24	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	53	0	31	3	0
3	B	53	0	31	2	0
4	B	26	0	16	0	0
5	A	67	134	0	0	0
5	B	82	164	0	0	0
All	All	3931	1082	3636	59	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 8.

All (59) 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:128:ILE:HG23	1:A:129:PRO:HD3	1.47	0.94
1:B:165:ARG:HA	1:B:168:LEU:HD12	1.74	0.70
1:A:211:LEU:O	1:A:214:ILE:HG12	2.00	0.62
1:A:172:GLN:HE22	1:A:186:PRO:HD3	1.64	0.61
1:A:190:PHE:O	1:A:203:MET:HE1	2.01	0.61
1:A:187:GLN:HE21	1:A:210:ARG:HH11	1.48	0.61
1:B:182:LYS:HD3	1:B:219:PRO:HG3	1.82	0.61
1:A:169:TRP:HB3	1:A:170:PRO:HD3	1.83	0.60
1:A:211:LEU:HA	1:A:214:ILE:HG23	1.85	0.58
1:B:169:TRP:HB3	1:B:170:PRO:HD3	1.87	0.56
1:A:199:GLU:O	1:A:203:MET:HG3	2.05	0.56
1:A:17:PHE:HZ	1:A:203:MET:HB2	1.71	0.55
1:A:165:ARG:HA	1:A:168:LEU:HD12	1.89	0.55
1:A:17:PHE:O	1:A:21:LEU:HG	2.07	0.55
1:A:197:GLU:O	1:A:201:LYS:HG2	2.06	0.54
1:B:148:THR:O	1:B:192:PRO:HD2	2.08	0.54
1:A:127:ASP:HB3	1:A:129:PRO:HD2	1.91	0.53
1:B:75:TYR:CE1	1:B:124:PHE:HB2	2.43	0.53
1:B:108:VAL:HG21	1:B:116:MET:CE	2.40	0.52
1:A:148:THR:OG1	1:A:190:PHE:HA	2.10	0.52
1:A:128:ILE:CG2	1:A:129:PRO:HD3	2.30	0.52
1:A:132:TYR:HA	1:A:177:HIS:O	2.10	0.52
1:B:187:GLN:HE21	1:B:210:ARG:HH11	1.59	0.51
1:B:141:LEU:HD23	1:B:182:LYS:HB2	1.92	0.50
1:B:108:VAL:HG21	1:B:116:MET:HE3	1.95	0.49
1:A:87:GLU:O	1:A:91:VAL:HG23	2.13	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:56:THR:O	1:A:79:SER:HB3	2.13	0.49
1:A:24:VAL:CG1	1:A:208:SER:HB3	2.43	0.48
1:B:112:LEU:HG	1:B:116:MET:HE2	1.95	0.48
1:B:209:GLN:HA	1:B:212:GLN:HE21	1.77	0.48
1:B:148:THR:O	1:B:191:ALA:HA	2.15	0.46
1:A:138:GLN:HA	1:A:180:GLY:O	2.15	0.46
1:A:125:ALA:HB1	1:A:179:CYS:SG	2.56	0.46
1:B:24:VAL:HG21	1:B:204:VAL:CG1	2.46	0.46
1:A:17:PHE:HB2	3:A:234:FAD:C5B	2.46	0.45
1:A:207:TRP:O	1:A:211:LEU:HG	2.16	0.45
1:A:15:LYS:O	3:A:234:FAD:H8A	2.17	0.44
1:B:20:SER:HB3	3:B:233:FAD:H61A	1.82	0.44
1:B:50:ALA:HB1	1:B:67:TYR:CZ	2.53	0.44
1:A:101:PHE:O	1:A:146:VAL:HA	2.17	0.43
1:B:138:GLN:HA	1:B:180:GLY:O	2.18	0.43
1:A:75:TYR:CE1	1:A:124:PHE:HB2	2.53	0.43
1:B:55:ILE:N	1:B:55:ILE:HD12	2.33	0.43
1:A:13:GLU:HA	1:A:14:PRO:HD3	1.88	0.42
1:B:48:PRO:HA	1:B:114:GLY:HA3	2.00	0.42
1:A:46:PHE:O	1:A:48:PRO:HD3	2.19	0.42
1:A:48:PRO:HA	1:A:114:GLY:HA3	2.01	0.42
1:A:67:TYR:CZ	1:A:71:THR:HG21	2.55	0.42
1:A:17:PHE:HB2	3:A:234:FAD:H51A	2.02	0.41
1:B:17:PHE:HB2	3:B:233:FAD:H51A	2.01	0.41
1:A:187:GLN:NE2	1:A:210:ARG:HH11	2.15	0.41
1:B:147:THR:HG22	1:B:189:SER:HB2	2.03	0.41
1:B:211:LEU:HA	1:B:214:ILE:HB	2.01	0.41
1:A:64:VAL:HG13	1:B:13:GLU:HG2	2.02	0.40
1:A:148:THR:O	1:A:192:PRO:HD2	2.21	0.40
1:A:191:ALA:HB1	1:A:194:ILE:HD12	2.04	0.40
1:A:214:ILE:HA	1:A:217:GLU:HG3	2.03	0.40
1:B:101:PHE:CZ	1:B:146:VAL:HG22	2.57	0.40
1:B:24:VAL:HG21	1:B:204:VAL:HG13	2.04	0.40

There are no symmetry-related clashes.

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	228/230 (99%)	217 (95%)	10 (4%)	1 (0%)	30	37
1	B	228/230 (99%)	216 (95%)	11 (5%)	1 (0%)	30	37
All	All	456/460 (99%)	433 (95%)	21 (5%)	2 (0%)	30	37

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	222	CYS
1	B	130	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	194/194 (100%)	189 (97%)	5 (3%)	40	55
1	B	194/194 (100%)	191 (98%)	3 (2%)	57	70
All	All	388/388 (100%)	380 (98%)	8 (2%)	47	62

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	31	ARG
1	A	76	LYS
1	A	128	ILE
1	A	146	VAL

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Mol	Chain	Res	Type
1	A	158	THR
1	B	24	VAL
1	B	85	THR
1	B	134	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	172	GLN
1	A	187	GLN
1	A	212	GLN
1	B	23	ASN
1	B	72	HIS
1	B	138	GLN
1	B	161	ASN
1	B	187	GLN
1	B	212	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 6 ligands modelled in this entry, 2 are monoatomic - leaving 4 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	FAD	A	234	-	58,58,58	1.18	4 (6%)	85,89,89	1.37	12 (14%)
3	FAD	B	233	-	58,58,58	1.33	7 (12%)	85,89,89	1.32	10 (11%)
4	VK3	B	236	-	14,14,14	1.23	0	20,20,20	1.90	4 (20%)
4	VK3	B	235	-	14,14,14	1.48	4 (28%)	20,20,20	1.96	5 (25%)

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	FAD	A	234	-	-	3/34/50/50	0/6/6/6
3	FAD	B	233	-	-	4/34/50/50	0/6/6/6
4	VK3	B	236	-	-	-	0/2/2/2
4	VK3	B	235	-	-	-	0/2/2/2

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	233	FAD	C1'-N10	-5.30	1.35	1.47
3	A	234	FAD	C1'-N10	-5.03	1.35	1.47
3	B	233	FAD	C4X-N5	3.74	1.38	1.30
3	A	234	FAD	C4X-N5	3.53	1.38	1.30
3	B	233	FAD	C10-N1	3.10	1.39	1.33
3	B	233	FAD	C1'-C2'	2.85	1.56	1.52
4	B	235	VK3	C5K-C4K	-2.63	1.43	1.48
4	B	235	VK3	C10-C1K	-2.55	1.43	1.48
3	A	234	FAD	C10-N1	2.46	1.38	1.33
3	B	233	FAD	C9-C8	-2.38	1.36	1.39
3	B	233	FAD	C6-C5X	-2.38	1.36	1.40
3	A	234	FAD	C9-C8	-2.32	1.36	1.39
3	B	233	FAD	C5'-C4'	2.20	1.54	1.51
4	B	235	VK3	C6K-C5K	-2.17	1.36	1.39
4	B	235	VK3	C9K-C10	-2.06	1.36	1.39

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	235	VK3	O4K-C4K-C3K	-5.36	114.39	120.33
4	B	236	VK3	O4K-C4K-C3K	-5.05	114.73	120.33
3	A	234	FAD	C10-N1-C2	4.75	127.13	116.85
3	B	233	FAD	C10-N1-C2	4.71	127.04	116.85
3	B	233	FAD	C4-C4X-C10	4.40	124.47	116.93
3	B	233	FAD	C4X-C10-N1	-4.27	114.12	124.59
3	A	234	FAD	C4X-C10-N1	-4.23	114.22	124.59
4	B	235	VK3	O4K-C4K-C5K	3.94	127.89	121.57
3	A	234	FAD	C4-C4X-C10	3.92	123.66	116.93
4	B	236	VK3	O4K-C4K-C5K	3.70	127.50	121.57
4	B	236	VK3	O1K-C1K-C2K	-3.37	116.49	121.88
4	B	235	VK3	O1K-C1K-C2K	-3.15	116.84	121.88
3	A	234	FAD	C4-C4X-N5	-2.85	114.27	118.21
3	A	234	FAD	N10-C10-N1	2.76	126.63	118.51
3	A	234	FAD	O4'-C4'-C5'	-2.76	103.91	109.99
3	B	233	FAD	N10-C10-N1	2.75	126.59	118.51
3	A	234	FAD	O4B-C1B-N9A	-2.68	102.95	108.09
3	A	234	FAD	C2B-C3B-C4B	-2.64	97.51	102.61
4	B	235	VK3	C3K-C2K-C1K	-2.59	119.87	123.25
3	B	233	FAD	O2-C2-N3	2.56	123.50	118.58
3	B	233	FAD	C4-C4X-N5	-2.51	114.74	118.21
4	B	236	VK3	C3K-C2K-C1K	-2.45	120.05	123.25
3	A	234	FAD	N3-C2-N1	-2.40	114.41	119.50
3	A	234	FAD	O2B-C2B-C1B	2.39	118.33	110.10
3	A	234	FAD	C3B-C2B-C1B	-2.33	97.06	101.46
3	B	233	FAD	O4B-C4B-C5B	-2.29	102.01	109.33
4	B	235	VK3	C2K-C3K-C4K	2.24	121.77	119.40
3	A	234	FAD	O4'-C4'-C3'	2.22	114.45	109.25
3	B	233	FAD	N3-C2-N1	-2.19	114.85	119.50
3	B	233	FAD	C3B-C2B-C1B	-2.17	97.36	101.46
3	B	233	FAD	C10-C4X-N5	-2.01	120.70	124.81

There are no chirality outliers.

All (7) torsion outliers are listed below:

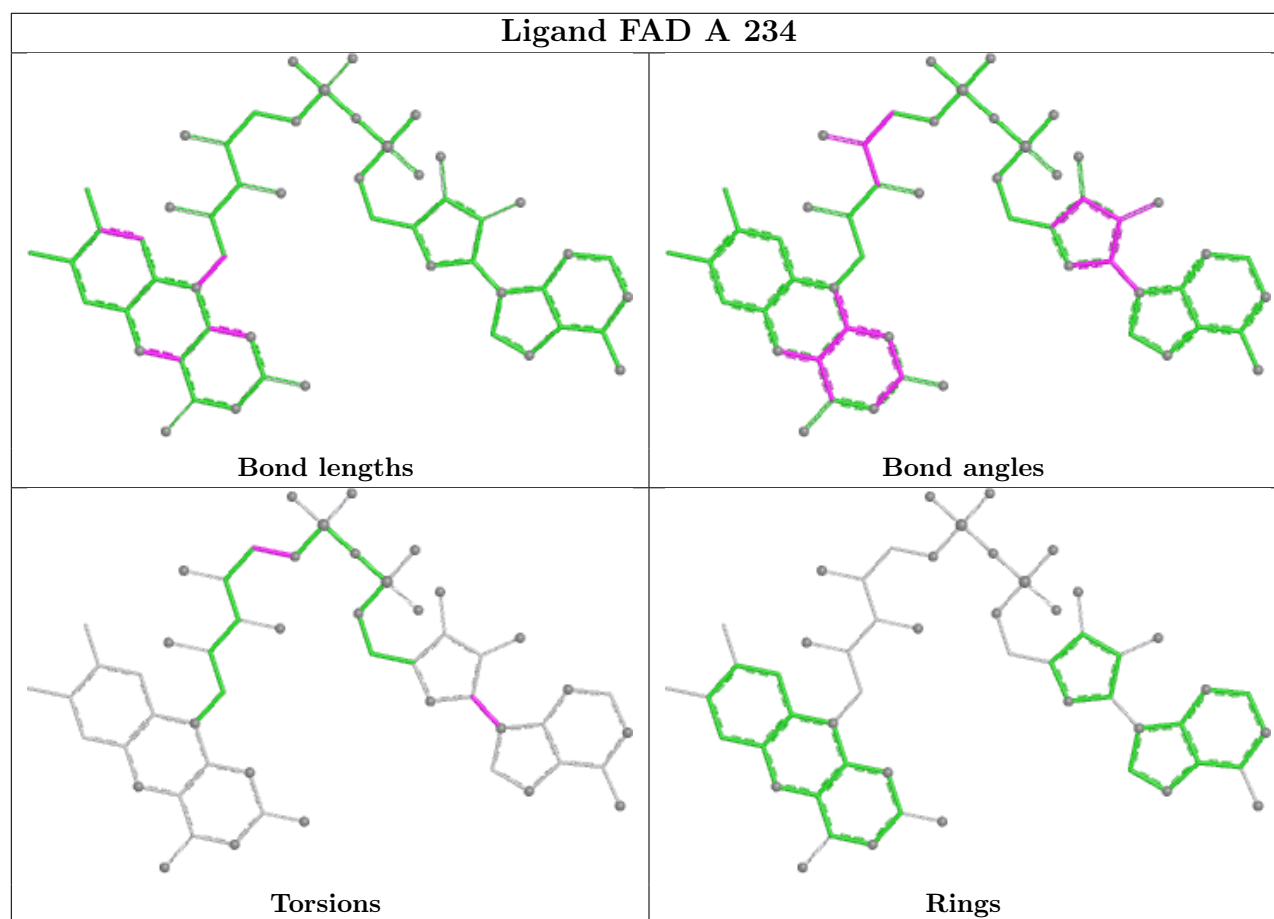
Mol	Chain	Res	Type	Atoms
3	B	233	FAD	C2B-C1B-N9A-C8A
3	B	233	FAD	C2B-C1B-N9A-C4A
3	A	234	FAD	C2B-C1B-N9A-C8A
3	A	234	FAD	C2B-C1B-N9A-C4A
3	B	233	FAD	C4'-C5'-O5'-P
3	A	234	FAD	C4'-C5'-O5'-P
3	B	233	FAD	O4B-C1B-N9A-C8A

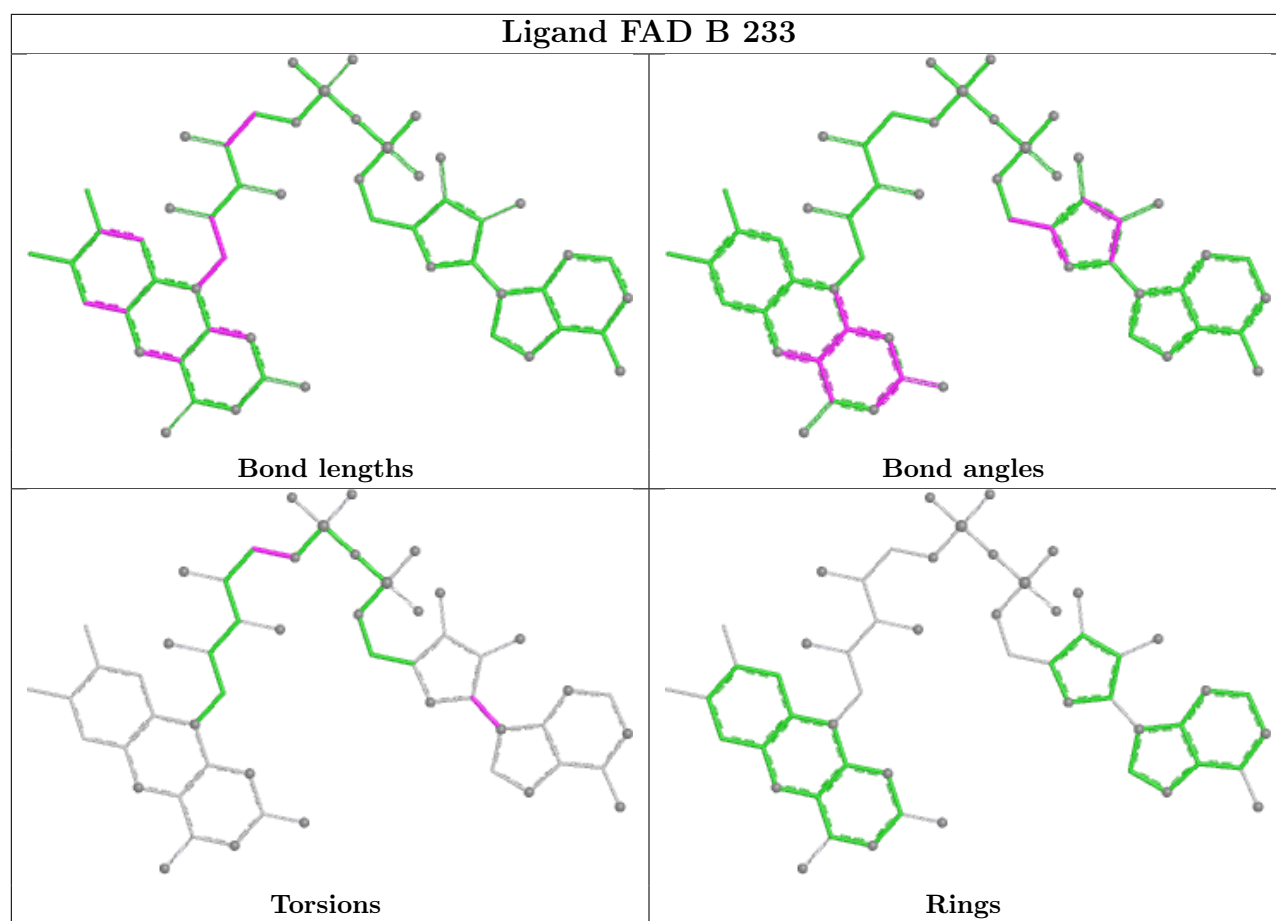
There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	234	FAD	3	0
3	B	233	FAD	2	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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.