



wwPDB X-ray Structure Validation Summary Report ⓘ

May 23, 2020 – 04:21 pm BST

PDB ID : 2VAO
Title : STRUCTURE OF THE OCTAMERIC FLAVOENZYME VANILLYL-ALCOHOL OXIDASE IN COMPLEX WITH ISOEUGENOL
Authors : Mattevi, A.
Deposited on : 1997-04-10
Resolution : 2.80 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

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)
Xtrriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
buster-report : 1.1.7 (2018)
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.11

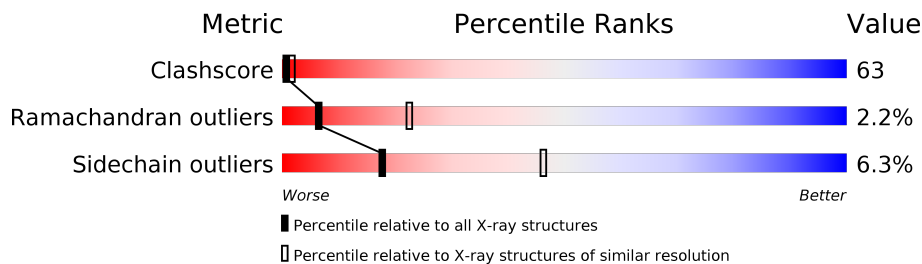
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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	141614	3569 (2.80-2.80)
Ramachandran outliers	138981	3498 (2.80-2.80)
Sidechain outliers	138945	3500 (2.80-2.80)

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 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	560	
1	B	560	

2 Entry composition [i](#)

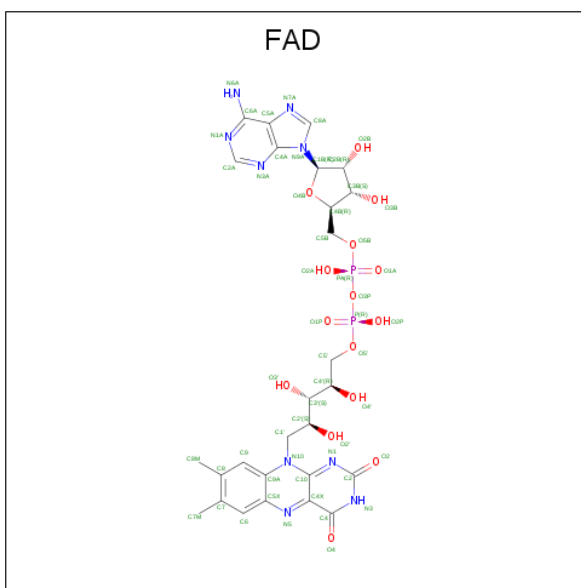
There are 4 unique types of molecules in this entry. The entry contains 8948 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 VANILLYL-ALCOHOL OXIDASE.

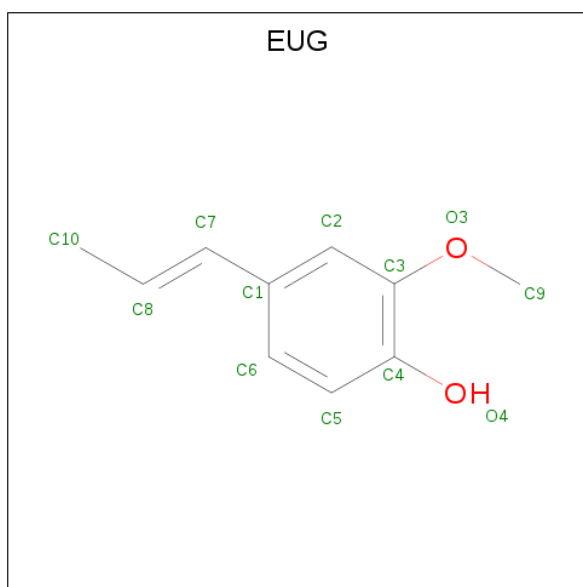
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	555	Total 4391	C 2817	N 751	O 799	S 24	51	0	0
1	B	555	Total 4391	C 2817	N 751	O 799	S 24	51	0	0

- 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
			Total	C	N	O	P		
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

- Molecule 3 is 2-methoxy-4-[(1E)-prop-1-en-1-yl]phenol (three-letter code: EUG) (formula: $C_{10}H_{12}O_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 11 9 2	0	0
3	B	1	Total C O 11 9 2	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	14	Total O 14 14	0	0
4	B	24	Total O 24 24	0	0

E515	F454	S393	R330	W268	X196	V130	V63
T516	I485	Y394	T331	L269	H197	L431	M64
Y517	G456	L395	E332	M270	S198	E132	Q66
N518	T457	R396	P333	P271	G199	V133	D65
W519	F458	L334	L334	M272	M201	M134	D67
N520	T459	S335	S335	P273	E200	V135	Y68
N521	V460	K400	E336	G274	V202	E136	F69
S522	R463	T401	L339	G275	V203	G137	L70
L525	E464	H402	L342	Y276	L204	A138	A71
R526	N465	Q403	I342	Q277	A205	Y139	S72
F527	H466	G404	I405	S278	L209	C140	A73
N528	H467	I406	I406	Y279	L210	V141	I74
E529	H468	F406	L346	L280	L211	V142	V75
W530	V469	T407	L347	I281	R211	E143	V75
L531	C470	D408	N347	T282	M214	P144	R78
N532	I471	D409	L283	L283	L214	T147	N79
N533	V472	E410	G349	P284	K285	Y148	V80
A534	F473	L411	R350	K285	L217	A81	A81
W535	M474	K412	W351	D286	K221	H149	D82
D536	K475	W413	N352	G287	R222	D150	V83
P537	K476	I414	F353	D288	R222	L151	Q84
N538	D477	D415	Y354	L289	P223	H152	S85
G539	L478	W416	G355	K290	E224	N153	I86
I540	I479	L417	A356	Q291	T225	W154	V87
I541	Q480	P418	L357	A292	M226	L155	G88
A542	R481	M419	W356	V293	G227	E156	L89
K545	R482	G420	G359	D294	L228	A157	A90
S546	K483	A421	P360	I295	K229	M158	N91
G547	V484	H422	E361	I296	P230	N159	K92
W548	K485	L423	P362	R297	E231	L160	F93
W549	W486	F424	I363	P298	D232	R161	S94
P550	L487	F425	R364	L299	Q233	K162	F95
S551	M488	S426	R365	R300	S236	K163	P96
W552	T490	P427	V366	L301	K237	L164	L97
S554	I492	I428	L367	G302	W165	W165	W98
H555	D493	S432	I371	M303	L166	L166	P99
T557	C495	G433	K372	A304	L171	L171	I102
W558	A496	F434	D373	L305	G172	G172	G103
K559	A497	A436	A374	Q306	P243	N105	N105
L560	M498	M437	F375	P309	Y244	G173	S106
G499	G499	M438	S376	R312	G247	W175	G107
W500	W500	Q459	A377	H313	P246	V176	Y108
G501	G501	Y440	I378	I314	Y249	L177	L108
E502	E502	A441	P379	L315	I250	G178	A111
Y503	Y503	V442	G380	L316	D251	N179	A112
R504	R504	T443	V381	D317	G252	R183	P113
T505	T505	K444	F382	A318	L253	G184	R114
H506	H506	K445	F383	A319	V185	V185	G117
L507	L507	R446	Y384	V320	Q256	G186	S118
A508	A508	C447	F385	L321	S257	T187	V119
F509	F509	Q448	P386	G322	N258	T188	V120
M510	M510	E449	E387	D323	M259	P189	L121
D511	D511	A450	D388	K324	K284	Y190	D122
Q512	Q512	G451	T389	R325	I265	G191	M127
I513	I513	L452	P390	S326	G266	W194	N128
N514	N514	D453	E391	Y327	I267	M195	R129

4 Data and refinement statistics

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

Property	Value	Source
Space group	I 4	Depositor
Cell constants a, b, c, α , β , γ	128.38Å 128.38Å 130.19Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 2.80	Depositor
% Data completeness (in resolution range)	90.6 (30.00-2.80)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.11	Depositor
Refinement program	TNT 5E	Depositor
R, R_{free}	0.214 , 0.290	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	8948	wwPDB-VP
Average B, all atoms (Å ²)	26.0	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: EUG, 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	0.81	3/4511 (0.1%)	1.88	127/6131 (2.1%)
1	B	0.81	2/4511 (0.0%)	1.88	128/6131 (2.1%)
All	All	0.81	5/9022 (0.1%)	1.88	255/12262 (2.1%)

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	A	2	0
1	B	2	0
All	All	4	0

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	268	TRP	CB-CG	-5.99	1.39	1.50
1	B	156	GLU	CG-CD	5.97	1.60	1.51
1	B	268	TRP	CB-CG	-5.95	1.39	1.50
1	A	156	GLU	CG-CD	5.94	1.60	1.51
1	A	244	TYR	CB-CG	-5.03	1.44	1.51

The worst 5 of 255 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	560	LEU	CB-CG-CD2	-12.85	89.15	111.00
1	A	560	LEU	CB-CG-CD2	-12.83	89.19	111.00
1	B	16	LEU	CA-CB-CG	-11.58	88.66	115.30
1	A	16	LEU	CA-CB-CG	-11.56	88.70	115.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	495	CYS	CA-CB-SG	-11.13	93.97	114.00

All (4) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	363	ILE	CA
1	A	410	GLU	CA
1	B	363	ILE	CA
1	B	410	GLU	CA

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	4391	0	4330	550	0
1	B	4391	0	4330	552	0
2	A	53	0	31	17	0
2	B	53	0	31	18	0
3	A	11	0	7	4	0
3	B	11	0	7	5	0
4	A	14	0	0	2	0
4	B	24	0	0	0	0
All	All	8948	0	8736	1088	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 63.

The worst 5 of 1088 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:422:HIS:NE2	2:B:600:FAD:HM81	1.45	1.12
1:A:422:HIS:NE2	2:A:600:FAD:HM82	1.42	1.10
2:B:600:FAD:H8A	2:B:600:FAD:H51A	1.27	1.08
1:A:422:HIS:NE2	2:A:600:FAD:HM81	1.45	1.08

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:A:600:FAD:H8A	2:A:600:FAD:H51A	1.27	1.08

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	553/560 (99%)	472 (85%)	69 (12%)	12 (2%)	6	22
1	B	553/560 (99%)	472 (85%)	69 (12%)	12 (2%)	6	22
All	All	1106/1120 (99%)	944 (85%)	138 (12%)	24 (2%)	6	22

5 of 24 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	46	ILE
1	A	559	LYS
1	B	46	ILE
1	B	559	LYS
1	A	157	ALA

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	475/482 (98%)	445 (94%)	30 (6%)	18	46

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	475/482 (98%)	445 (94%)	30 (6%)	18	46
All	All	950/964 (98%)	890 (94%)	60 (6%)	18	46

5 of 60 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	505	THR
1	B	78	ARG
1	B	488	MET
1	B	27	ASP
1	B	91	ASN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 29 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	533	ASN
1	B	91	ASN
1	B	528	ASN
1	A	552	GLN
1	B	152	HIS

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](#)

4 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	600	1	51,58,58	1.12	4 (7%)	60,89,89	1.63	6 (10%)
3	EUG	A	601	-	11,11,12	0.45	0	14,14,15	1.51	2 (14%)
3	EUG	B	601	-	11,11,12	0.45	0	14,14,15	1.52	2 (14%)
2	FAD	B	600	1	51,58,58	1.12	4 (7%)	60,89,89	1.63	6 (10%)

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	600	1	-	10/30/50/50	0/6/6/6
3	EUG	A	601	-	-	4/4/4/5	0/1/1/1
3	EUG	B	601	-	-	4/4/4/5	0/1/1/1
2	FAD	B	600	1	-	10/30/50/50	0/6/6/6

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	600	FAD	C4-N3	3.68	1.39	1.33
2	B	600	FAD	C4-N3	3.64	1.39	1.33
2	B	600	FAD	C4X-C10	3.59	1.42	1.38
2	A	600	FAD	C4X-C10	3.55	1.42	1.38
2	B	600	FAD	C2-N1	-2.93	1.32	1.38

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	600	FAD	C4-N3-C2	7.45	121.43	115.14
2	A	600	FAD	C4-N3-C2	7.44	121.42	115.14
2	A	600	FAD	C4X-C4-N3	-5.53	115.87	123.43
2	B	600	FAD	C4X-C4-N3	-5.51	115.90	123.43
2	B	600	FAD	C1'-N10-C9A	4.24	121.63	118.29

There are no chirality outliers.

5 of 28 torsion outliers are listed below:

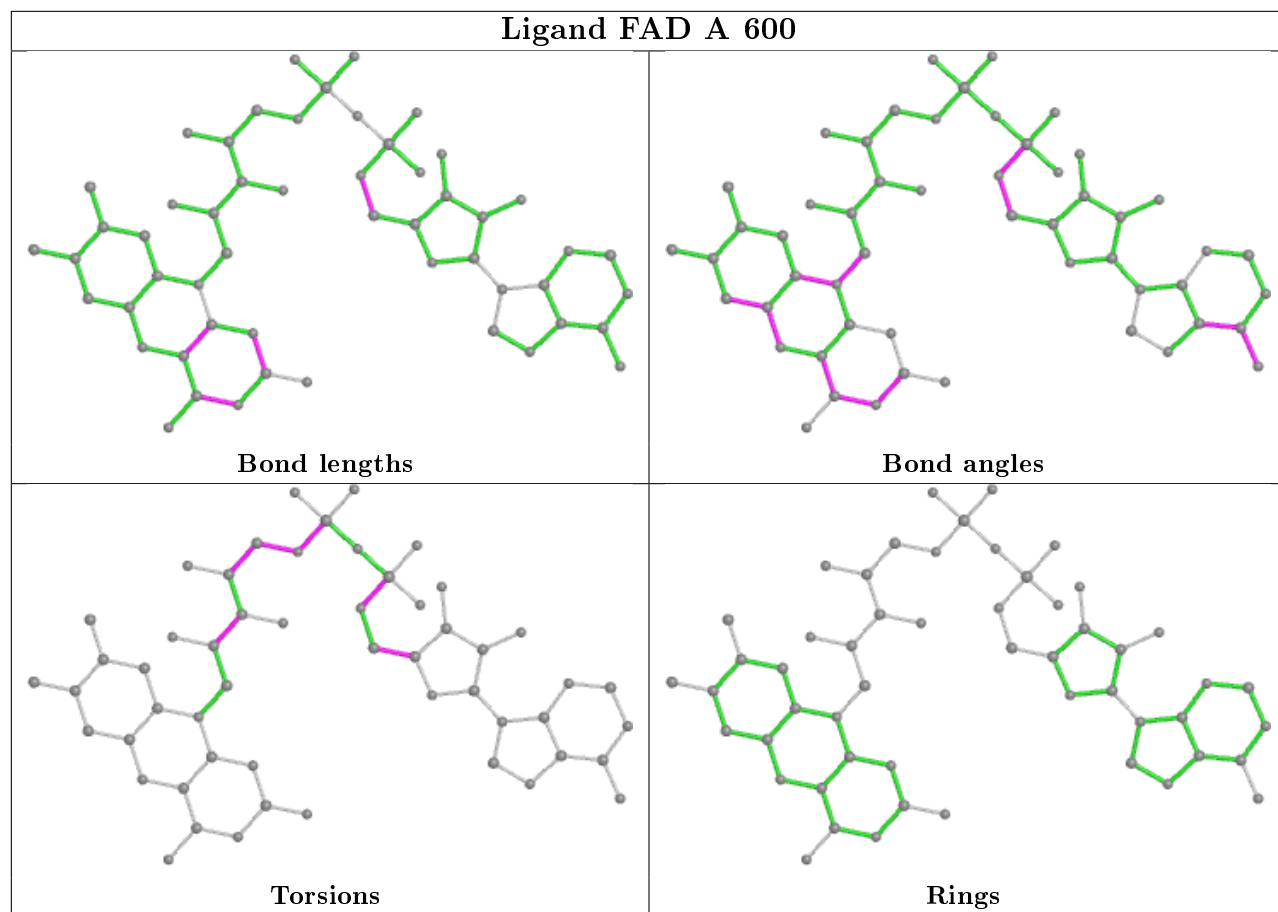
Mol	Chain	Res	Type	Atoms
2	A	600	FAD	C5B-O5B-PA-O3P
2	A	600	FAD	C5'-O5'-P-O1P
2	B	600	FAD	C5B-O5B-PA-O3P
2	B	600	FAD	C5'-O5'-P-O1P
3	A	601	EUG	C6-C1-C7-C8

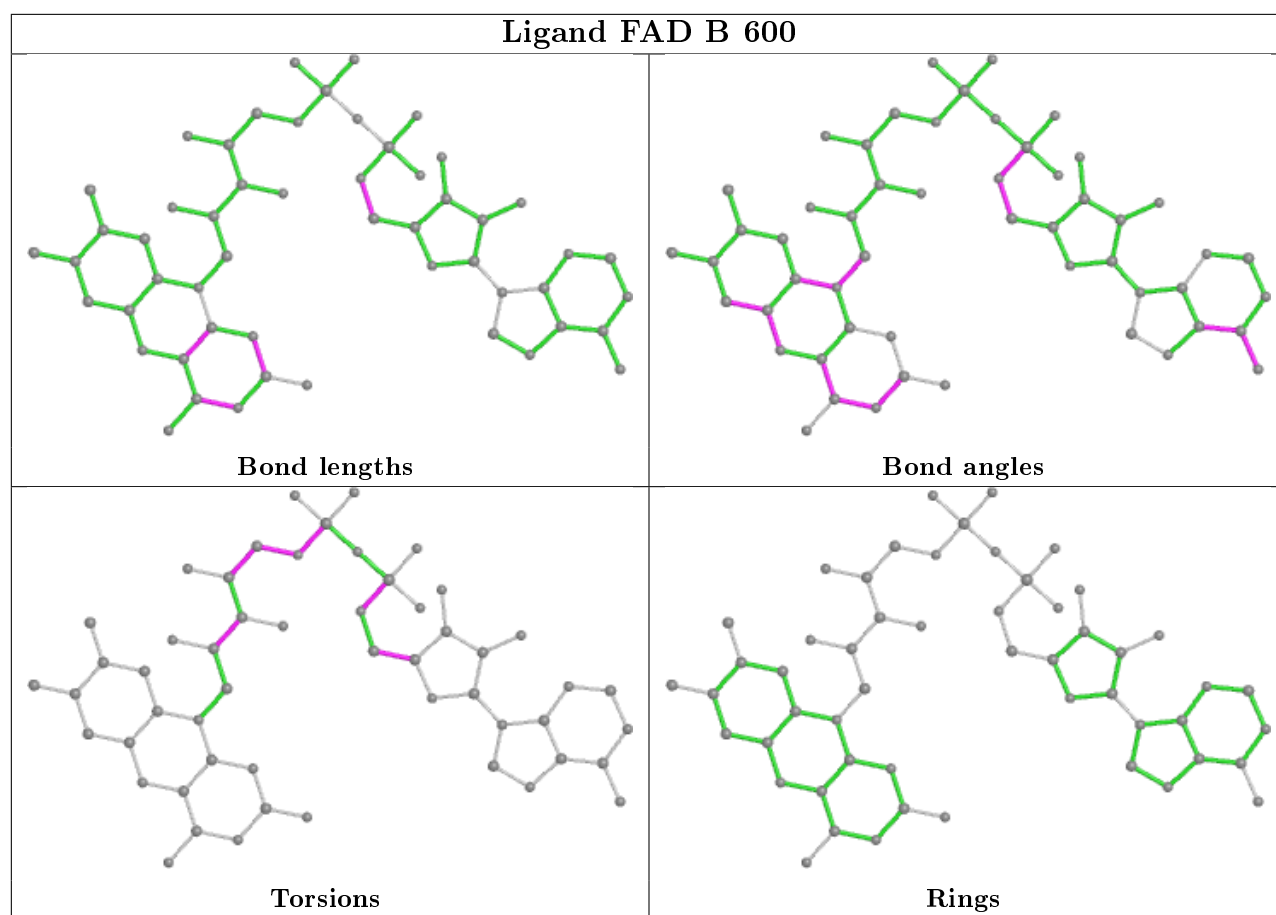
There are no ring outliers.

4 monomers are involved in 38 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	600	FAD	17	0
3	A	601	EUG	4	0
3	B	601	EUG	5	0
2	B	600	FAD	18	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.