



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 08:28 PM UTC

PDB ID : 4KPR / pdb_00004kpr
Title : Tetrameric form of rat selenoprotein thioredoxin reductase 1
Authors : Lindqvist, Y.; Sandalova, T.; Xu, J.; Arner, E.
Deposited on : 2013-05-14
Resolution : 2.40 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) : 2.0
EDS : 3.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

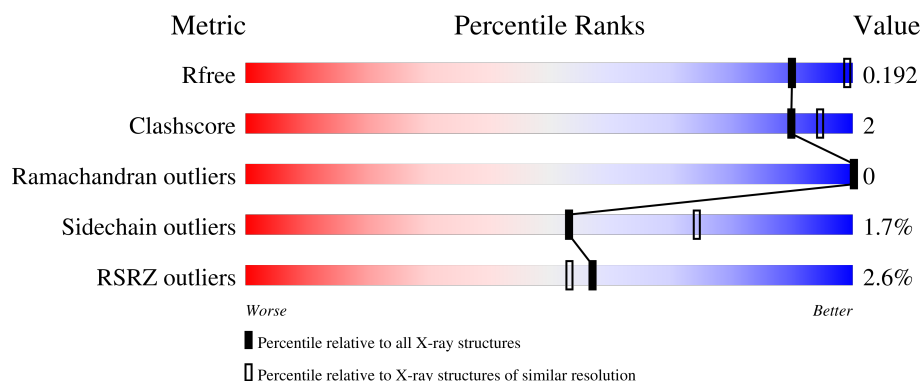
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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}	180053	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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 $\leq 5\%$. 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	499	7% 91% 6% .
1	B	499	2% 91% 6% .
1	E	499	% 92% 5% .
1	F	499	% 88% 9% .

2 Entry composition [i](#)

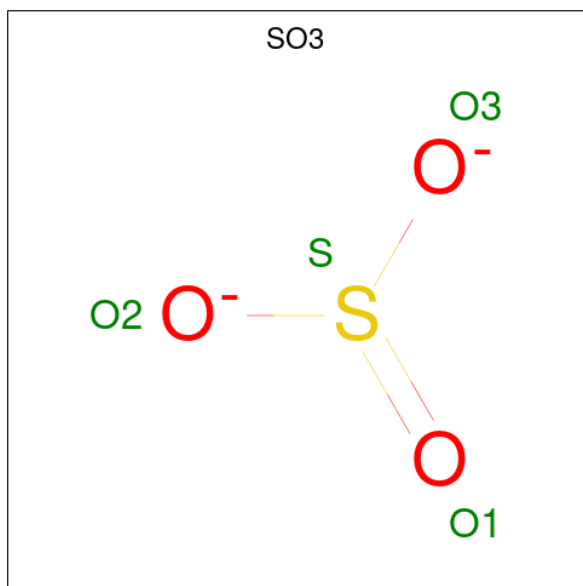
There are 5 unique types of molecules in this entry. The entry contains 15853 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Thioredoxin reductase 1, cytoplasmic.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	E	484	Total	C	N	O	S	0	1	0
			3737	2378	631	708	20			
1	F	485	Total	C	N	O	S	0	6	0
			3787	2413	639	715	20			
1	A	484	Total	C	N	O	S	0	1	0
			3741	2381	632	708	20			
1	B	484	Total	C	N	O	S	0	5	0
			3768	2400	636	712	20			

- Molecule 2 is SULFITE ION (CCD ID: SO3) (formula: O₃S).



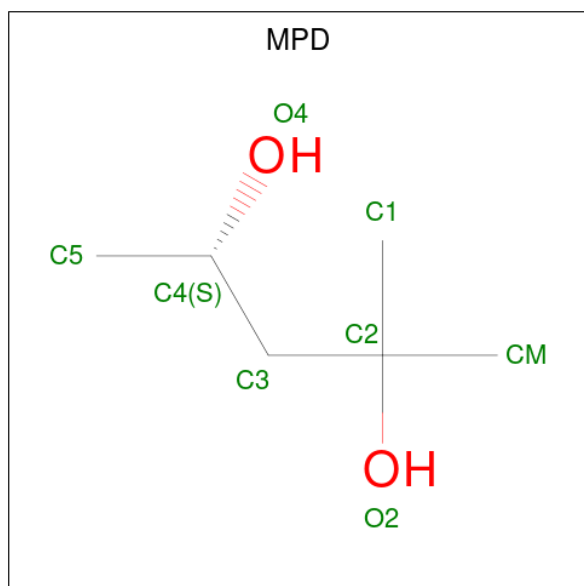
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	E	1	Total	O	S	0	0
			4	3	1		
2	F	1	Total	O	S	0	0
			4	3	1		

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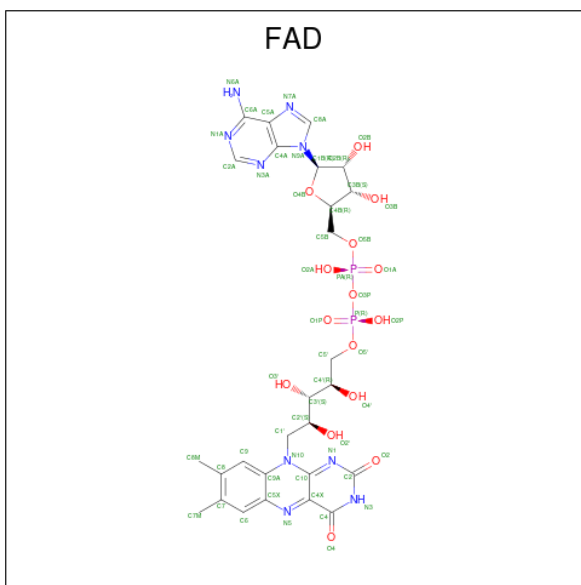
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	F	1	Total	O	S	0	0
			4	3	1		

- Molecule 3 is (4S)-2-METHYL-2,4-PENTANEDIOL (CCD ID: MPD) (formula: C₆H₁₄O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	E	1	Total	C	O	0	0
			8	6	2		
3	E	1	Total	C	O	0	0
			8	6	2		
3	E	1	Total	C	O	0	0
			8	6	2		
3	F	1	Total	C	O	0	0
			8	6	2		
3	F	1	Total	C	O	0	0
			8	6	2		
3	A	1	Total	C	O	0	0
			8	6	2		
3	A	1	Total	C	O	0	0
			8	6	2		
3	A	1	Total	C	O	0	0
			8	6	2		
3	B	1	Total	C	O	0	0
			8	6	2		

- Molecule 4 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula: C₂₇H₃₃N₉O₁₅P₂).



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

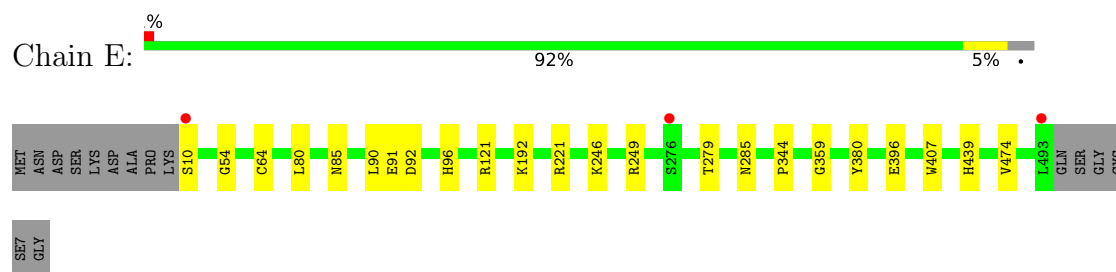
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	E	173	Total O 173 173	0	0
5	F	191	Total O 191 191	0	0
5	A	34	Total O 34 34	0	0
5	B	126	Total O 126 126	0	0

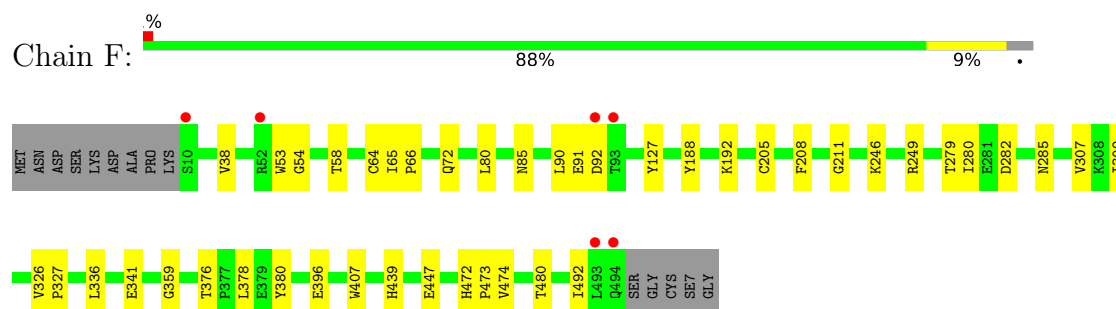
3 Residue-property plots [i](#)

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 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.

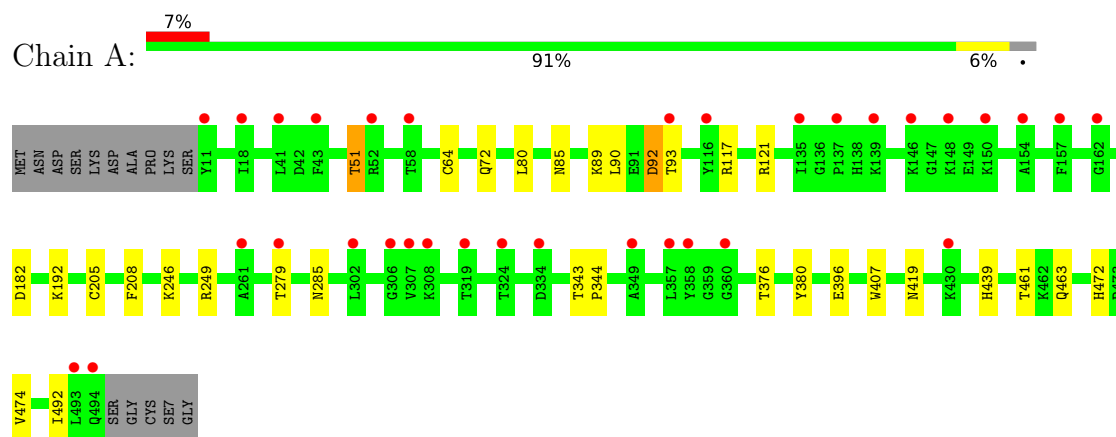
- Molecule 1: Thioredoxin reductase 1, cytoplasmic



- Molecule 1: Thioredoxin reductase 1, cytoplasmic

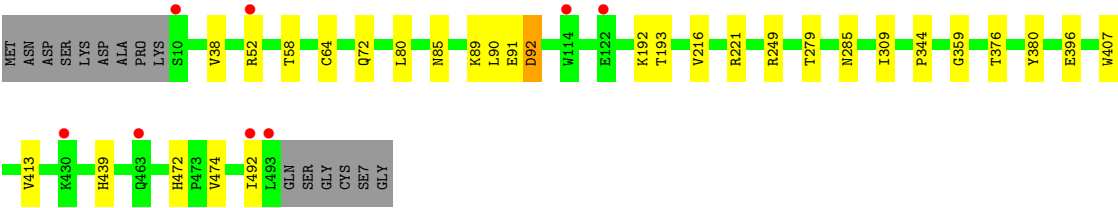


- Molecule 1: Thioredoxin reductase 1, cytoplasmic



- Molecule 1: Thioredoxin reductase 1, cytoplasmic





4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	162.99Å 162.99Å 236.44Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	60.67 – 2.40 60.67 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.6 (60.67-2.40) 99.6 (60.67-2.40)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.71 (at 2.40Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.160 , 0.187 0.170 , 0.192	Depositor DCC
R_{free} test set	7095 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	48.7	Xtriage
Anisotropy	0.236	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 48.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.016 for -h,-k,l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	15853	wwPDB-VP
Average B, all atoms (Å ²)	61.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.27% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: MPD, SO3, 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	1.06	2/3818 (0.1%)	0.99	3/5166 (0.1%)
1	B	1.24	7/3850 (0.2%)	1.05	4/5211 (0.1%)
1	E	1.31	3/3814 (0.1%)	1.07	4/5161 (0.1%)
1	F	1.33	14/3879 (0.4%)	1.07	1/5250 (0.0%)
All	All	1.24	26/15361 (0.2%)	1.05	12/20788 (0.1%)

All (26) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	359	GLY	C-O	-10.44	1.16	1.24
1	E	407	TRP	C-O	-9.99	1.16	1.25
1	F	359	GLY	C-O	-8.42	1.18	1.24
1	B	216	VAL	C-O	-7.05	1.17	1.24
1	A	407	TRP	C-O	-7.00	1.18	1.24
1	B	359	GLY	C-O	-6.96	1.19	1.24
1	F	336	LEU	C-O	-6.82	1.15	1.23
1	F	54	GLY	C-O	-6.62	1.17	1.23
1	F	309	ILE	C-O	-6.28	1.16	1.23
1	F	38	VAL	C-O	-6.06	1.18	1.24
1	F	447	GLU	CD-OE2	6.05	1.36	1.25
1	F	407	TRP	C-O	-5.99	1.19	1.24
1	B	58	THR	N-CA	-5.73	1.39	1.46
1	A	343	THR	C-O	-5.54	1.19	1.24
1	B	38	VAL	C-O	-5.48	1.18	1.24
1	B	193	THR	N-CA	-5.43	1.39	1.46
1	F	58	THR	N-CA	-5.38	1.40	1.46
1	B	309	ILE	C-O	-5.32	1.16	1.23
1	F	307	VAL	C-O	-5.30	1.18	1.24
1	B	407	TRP	C-O	-5.29	1.20	1.25
1	F	53	TRP	C-O	-5.25	1.18	1.23
1	F	480	THR	C-O	-5.20	1.17	1.24

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	F	127	TYR	C-O	-5.16	1.18	1.24
1	E	96	HIS	C-O	-5.09	1.17	1.24
1	F	341	GLU	C-O	-5.07	1.16	1.23
1	F	211	GLY	C-O	-5.01	1.17	1.24

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	492	ILE	N-CA-C	8.40	120.16	112.43
1	E	92	ASP	N-CA-C	6.41	117.93	111.07
1	F	492	ILE	N-CA-C	6.36	119.30	113.20
1	B	221	ARG	NE-CZ-NH2	6.01	124.61	119.20
1	E	221	ARG	NE-CZ-NH2	5.57	124.21	119.20
1	B	92	ASP	N-CA-C	5.44	116.89	111.07
1	A	419	ASN	N-CA-C	5.41	118.90	111.54
1	E	91	GLU	N-CA-C	5.41	117.27	110.24
1	A	92	ASP	N-CA-C	5.35	116.80	111.07
1	E	54	GLY	N-CA-C	5.21	120.23	112.41
1	A	492	ILE	N-CA-C	5.19	118.13	113.10
1	B	221	ARG	NE-CZ-NH1	-5.08	116.42	121.50

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	3741	0	3753	18	0
1	B	3768	0	3776	16	0
1	E	3737	0	3748	13	0
1	F	3787	0	3797	22	0
2	E	4	0	0	0	0
2	F	8	0	0	0	0
3	A	24	0	42	2	0
3	B	8	0	14	1	0
3	E	24	0	42	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	F	16	0	28	2	0
4	A	53	0	31	0	0
4	B	53	0	31	0	0
4	E	53	0	31	0	0
4	F	53	0	31	0	0
5	A	34	0	0	1	0
5	B	126	0	0	4	0
5	E	173	0	0	3	0
5	F	191	0	0	1	0
All	All	15853	0	15324	55	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 2.

All (55) 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:85:ASN:HB2	5:A:617:HOH:O	1.79	0.81
1:E:85:ASN:HB2	5:E:643:HOH:O	1.85	0.77
1:B:85:ASN:HB2	5:B:690:HOH:O	1.96	0.66
1:E:90:LEU:HD11	1:F:90:LEU:HD11	1.77	0.66
1:B:249:ARG:HG2	3:B:501:MPD:H53	1.79	0.65
1:F:380:TYR:OH	1:F:439:HIS:HD2	1.81	0.63
1:E:380:TYR:OH	1:E:439:HIS:HD2	1.83	0.62
1:F:85:ASN:HB2	5:F:610:HOH:O	2.00	0.62
1:B:192:LYS:H	1:B:285:ASN:HD22	1.48	0.61
1:F:282:ASP:OD1	1:A:117:ARG:NH2	2.35	0.60
1:A:51:THR:OG1	1:A:182:ASP:OD1	2.18	0.59
1:A:90:LEU:HD11	1:B:90:LEU:HD11	1.84	0.59
1:F:91:GLU:OE2	1:B:89:LYS:NZ	2.35	0.59
1:A:380:TYR:OH	1:A:439:HIS:HD2	1.86	0.59
1:B:380:TYR:OH	1:B:439:HIS:HD2	1.86	0.59
1:F:280:ILE:HG22	1:A:121:ARG:HD2	1.86	0.58
1:A:192:LYS:H	1:A:285:ASN:HD22	1.51	0.57
1:F:192:LYS:H	1:F:285:ASN:HD22	1.52	0.56
1:E:90:LEU:CD1	1:F:90:LEU:HD11	2.35	0.56
1:E:249:ARG:NH1	3:E:503:MPD:O2	2.39	0.56
1:E:90:LEU:HD11	1:F:90:LEU:CD1	2.36	0.55
1:E:192:LYS:H	1:E:285:ASN:HD22	1.54	0.54
1:E:10:SER:N	5:E:609:HOH:O	2.42	0.52
1:F:249:ARG:HG2	3:F:503:MPD:H53	1.90	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:91:GLU:HG2	1:B:92:ASP:N	2.25	0.52
1:A:461:THR:OG1	1:A:463[A]:GLN:HG2	2.12	0.50
1:F:188:TYR:HE2	3:F:504:MPD:HM2	1.75	0.49
1:A:90:LEU:CD1	1:B:90:LEU:HD11	2.42	0.49
1:A:72:GLN:HE21	1:A:72:GLN:HA	1.78	0.48
1:A:90:LEU:HD11	1:B:90:LEU:CD1	2.43	0.48
1:E:80:LEU:HD23	1:F:80:LEU:HD23	1.96	0.48
1:A:249:ARG:HD3	3:A:502:MPD:O4	2.14	0.48
1:B:52:ARG:CD	5:B:612:HOH:O	2.61	0.48
1:F:282:ASP:CG	1:A:117:ARG:HH21	2.20	0.48
1:A:472:HIS:HB2	1:B:344:PRO:HG3	1.97	0.47
1:A:80:LEU:HD23	1:B:80:LEU:HD23	1.97	0.46
1:E:249:ARG:HG2	3:E:503:MPD:H53	1.96	0.46
1:E:10:SER:HA	5:E:609:HOH:O	2.15	0.46
1:F:91:GLU:CG	1:F:92:ASP:N	2.79	0.46
1:A:344:PRO:HG3	1:B:472:HIS:HB2	1.98	0.45
1:E:344:PRO:HG3	1:F:472:HIS:HB2	1.98	0.45
1:A:205:CYS:HA	1:A:208:PHE:CE2	2.52	0.44
1:F:380:TYR:OH	1:F:439:HIS:CD2	2.68	0.43
1:F:65:ILE:HB	1:F:66:PRO:CD	2.49	0.42
1:F:472:HIS:HA	1:F:473:PRO:HA	1.86	0.42
1:F:378:LEU:HD12	1:F:378:LEU:HA	1.94	0.42
1:B:72:GLN:HA	1:B:72:GLN:HE21	1.85	0.42
1:F:205:CYS:HA	1:F:208:PHE:CE2	2.55	0.42
1:B:380:TYR:OH	1:B:439:HIS:CD2	2.72	0.42
1:F:72:GLN:HE21	1:F:72:GLN:HA	1.85	0.41
1:F:326:VAL:HA	1:F:327:PRO:HD3	1.87	0.41
1:B:52:ARG:HD3	5:B:612:HOH:O	2.19	0.41
1:E:121:ARG:CD	5:B:704:HOH:O	2.69	0.41
1:A:380:TYR:OH	1:A:439:HIS:CD2	2.71	0.41
3:A:503:MPD:H52	3:A:503:MPD:HM1	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	483/499 (97%)	468 (97%)	15 (3%)	0	100	100
1	B	487/499 (98%)	472 (97%)	15 (3%)	0	100	100
1	E	483/499 (97%)	468 (97%)	15 (3%)	0	100	100
1	F	489/499 (98%)	475 (97%)	14 (3%)	0	100	100
All	All	1942/1996 (97%)	1883 (97%)	59 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	403/413 (98%)	393 (98%)	10 (2%)	42	64
1	B	406/413 (98%)	400 (98%)	6 (2%)	57	77
1	E	403/413 (98%)	398 (99%)	5 (1%)	63	81
1	F	409/413 (99%)	403 (98%)	6 (2%)	57	77
All	All	1621/1652 (98%)	1594 (98%)	27 (2%)	53	74

All (27) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	64	CYS
1	E	246	LYS
1	E	279	THR
1	E	396	GLU
1	E	474	VAL
1	F	64	CYS
1	F	246	LYS
1	F	279	THR
1	F	376	THR
1	F	396	GLU

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Mol	Chain	Res	Type
1	F	474	VAL
1	A	51	THR
1	A	64	CYS
1	A	89	LYS
1	A	92	ASP
1	A	93	THR
1	A	246	LYS
1	A	279	THR
1	A	376	THR
1	A	396	GLU
1	A	474	VAL
1	B	64	CYS
1	B	279	THR
1	B	376	THR
1	B	396	GLU
1	B	413	VAL
1	B	474	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (24) such sidechains are listed below:

Mol	Chain	Res	Type
1	E	113	ASN
1	E	285	ASN
1	E	398	ASN
1	E	419	ASN
1	E	439	HIS
1	F	61	ASN
1	F	72	GLN
1	F	113	ASN
1	F	129	ASN
1	F	285	ASN
1	F	398	ASN
1	F	439	HIS
1	A	61	ASN
1	A	72	GLN
1	A	113	ASN
1	A	285	ASN
1	A	398	ASN
1	A	439	HIS
1	B	61	ASN
1	B	72	GLN
1	B	113	ASN

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Mol	Chain	Res	Type
1	B	285	ASN
1	B	398	ASN
1	B	439	HIS

5.3.3 RNA ⓘ

There are no RNA molecules 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 oligosaccharides 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	$\# Z > 2$
3	MPD	A	502	-	7,7,7	0.82	0	9,10,10	1.15	1 (11%)
3	MPD	B	501	-	7,7,7	0.81	0	9,10,10	1.26	1 (11%)
4	FAD	E	505	-	58,58,58	1.74	15 (25%)	85,89,89	1.89	18 (21%)
3	MPD	A	501	-	7,7,7	0.87	0	9,10,10	1.06	0
2	SO3	E	501	-	1,3,3	7.84	1 (100%)	0,3,3	-	-
3	MPD	E	503	-	7,7,7	0.66	0	9,10,10	0.87	0
4	FAD	F	505	-	58,58,58	2.02	16 (27%)	85,89,89	1.60	15 (17%)
2	SO3	F	502	-	1,3,3	8.41	1 (100%)	0,3,3	-	-
3	MPD	A	503	-	7,7,7	0.49	0	9,10,10	0.82	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
2	SO3	F	501	-	1,3,3	9.55	1 (100%)	0,3,3	-	-
3	MPD	F	503	-	7,7,7	1.15	1 (14%)	9,10,10	1.38	1 (11%)
4	FAD	A	504	-	58,58,58	1.86	13 (22%)	85,89,89	2.05	27 (31%)
4	FAD	B	502	-	58,58,58	1.76	16 (27%)	85,89,89	1.81	23 (27%)
3	MPD	F	504	-	7,7,7	0.70	0	9,10,10	2.12	2 (22%)
3	MPD	E	504	-	7,7,7	0.72	0	9,10,10	1.36	1 (11%)
3	MPD	E	502	-	7,7,7	0.60	0	9,10,10	1.70	2 (22%)

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	MPD	A	502	-	-	0/5/5/5	-
3	MPD	B	501	-	-	0/5/5/5	-
4	FAD	E	505	-	-	7/34/50/50	0/6/6/6
3	MPD	A	501	-	-	0/5/5/5	-
4	FAD	F	505	-	-	6/34/50/50	0/6/6/6
3	MPD	E	503	-	-	0/5/5/5	-
3	MPD	A	503	-	-	0/5/5/5	-
3	MPD	F	503	-	-	0/5/5/5	-
4	FAD	A	504	-	-	8/34/50/50	0/6/6/6
4	FAD	B	502	-	-	5/34/50/50	0/6/6/6
3	MPD	F	504	-	-	2/5/5/5	-
3	MPD	E	504	-	-	2/5/5/5	-
3	MPD	E	502	-	-	3/5/5/5	-

All (64) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	F	501	SO3	O1-S	9.55	1.85	1.44
2	F	502	SO3	O1-S	8.41	1.80	1.44
2	E	501	SO3	O1-S	7.84	1.77	1.44
4	A	504	FAD	P-O3P	5.98	1.66	1.59
4	F	505	FAD	C9A-C5X	5.75	1.50	1.41
4	F	505	FAD	C4-N3	-5.34	1.28	1.38
4	B	502	FAD	C4-N3	-5.16	1.29	1.38
4	A	504	FAD	C9A-C5X	5.04	1.49	1.41

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	504	FAD	PA-O3P	4.79	1.64	1.59
4	A	504	FAD	C5A-C4A	4.75	1.47	1.39
4	F	505	FAD	C2'-C3'	-4.34	1.45	1.53
4	F	505	FAD	C2-N3	-4.33	1.29	1.39
4	E	505	FAD	C4-N3	-4.16	1.31	1.38
4	F	505	FAD	C4A-N9A	-4.08	1.29	1.37
4	F	505	FAD	C5X-N5	-3.95	1.32	1.39
4	B	502	FAD	C9-C9A	-3.89	1.33	1.39
4	E	505	FAD	C9-C9A	-3.88	1.33	1.39
4	B	502	FAD	C6-C7	-3.82	1.34	1.39
4	E	505	FAD	C2'-C3'	-3.81	1.46	1.53
4	E	505	FAD	C9A-C5X	3.75	1.47	1.41
4	E	505	FAD	O4B-C1B	3.48	1.50	1.42
4	F	505	FAD	C8-C7	3.28	1.48	1.40
4	F	505	FAD	C5A-N7A	-3.27	1.33	1.39
4	E	505	FAD	C4'-C3'	-3.17	1.47	1.53
4	A	504	FAD	C8-C7	3.11	1.48	1.40
4	F	505	FAD	P-O3P	-3.08	1.56	1.59
4	B	502	FAD	P-O3P	-3.07	1.56	1.59
4	B	502	FAD	C5X-N5	-3.05	1.33	1.39
4	E	505	FAD	P-O2P	-2.95	1.41	1.55
4	B	502	FAD	P-O1P	-2.93	1.40	1.50
4	A	504	FAD	C4-N3	-2.88	1.33	1.38
4	F	505	FAD	C6-C7	-2.86	1.35	1.39
4	E	505	FAD	C5X-N5	-2.85	1.34	1.39
4	B	502	FAD	C5A-C6A	2.85	1.48	1.41
4	B	502	FAD	C8A-N9A	-2.84	1.32	1.37
4	F	505	FAD	C8A-N9A	-2.84	1.32	1.37
4	F	505	FAD	C5A-C6A	2.78	1.48	1.41
4	B	502	FAD	C2-N3	-2.76	1.32	1.39
4	B	502	FAD	C9A-C5X	2.73	1.45	1.41
4	A	504	FAD	C5A-C6A	2.73	1.48	1.41
4	E	505	FAD	C2-N3	-2.71	1.33	1.39
4	A	504	FAD	C10-N10	2.63	1.43	1.37
4	E	505	FAD	C6-C5X	-2.54	1.36	1.40
4	B	502	FAD	C8-C7	2.53	1.47	1.40
4	E	505	FAD	PA-O3P	-2.51	1.56	1.59
4	E	505	FAD	C6-C7	-2.51	1.36	1.39
4	A	504	FAD	C5X-N5	-2.49	1.34	1.39
4	E	505	FAD	O4-C4	2.32	1.28	1.23
4	F	505	FAD	C2A-N1A	2.29	1.38	1.33
4	A	504	FAD	C2-N3	-2.28	1.34	1.39

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	E	505	FAD	C9-C8	-2.22	1.36	1.39
4	B	502	FAD	PA-O1A	-2.21	1.43	1.50
4	A	504	FAD	C4X-N5	2.20	1.35	1.30
4	E	505	FAD	C1'-C2'	-2.19	1.49	1.52
4	B	502	FAD	C5A-C4A	2.17	1.43	1.39
4	A	504	FAD	C2A-N1A	2.16	1.37	1.33
4	F	505	FAD	C1'-C2'	-2.14	1.49	1.52
3	F	503	MPD	C1-C2	2.13	1.58	1.52
4	F	505	FAD	PA-O2A	-2.11	1.45	1.55
4	A	504	FAD	C8A-N7A	2.10	1.35	1.31
4	B	502	FAD	C4A-N9A	-2.10	1.33	1.37
4	B	502	FAD	C8M-C8	-2.08	1.47	1.51
4	B	502	FAD	C8A-N7A	2.04	1.35	1.31
4	F	505	FAD	C9-C9A	-2.02	1.36	1.39

All (91) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	E	505	FAD	N3A-C2A-N1A	-6.29	119.07	128.58
4	A	504	FAD	C4A-N9A-C8A	5.81	111.83	105.74
4	B	502	FAD	C5A-C4A-N3A	-5.60	119.01	126.72
4	E	505	FAD	C4A-N9A-C8A	5.38	111.38	105.74
4	A	504	FAD	N3A-C4A-N9A	5.16	135.95	127.17
4	F	505	FAD	N3A-C2A-N1A	-4.80	121.32	128.58
4	A	504	FAD	O2A-PA-O3P	-4.67	94.65	107.27
3	F	504	MPD	CM-C2-C1	4.32	120.30	110.63
4	E	505	FAD	N3A-C4A-N9A	4.29	134.47	127.17
4	B	502	FAD	N3A-C4A-N9A	4.29	134.46	127.17
4	A	504	FAD	N3A-C2A-N1A	-4.22	122.19	128.58
4	E	505	FAD	C2A-N3A-C4A	4.17	122.02	111.83
4	F	505	FAD	C5'-C4'-C3'	-4.01	104.64	112.22
4	B	502	FAD	C2A-N3A-C4A	3.93	121.43	111.83
4	F	505	FAD	C5A-C4A-N3A	-3.91	121.33	126.72
3	F	504	MPD	O2-C2-CM	-3.90	95.82	107.99
4	B	502	FAD	N3A-C2A-N1A	-3.86	122.74	128.58
4	A	504	FAD	O2'-C2'-C3'	3.82	118.20	109.25
4	A	504	FAD	C5A-C4A-N3A	-3.81	121.46	126.72
4	B	502	FAD	C4A-N9A-C8A	3.79	109.71	105.74
4	E	505	FAD	C5A-C4A-N3A	-3.77	121.52	126.72
4	F	505	FAD	N3A-C4A-N9A	3.66	133.40	127.17
4	F	505	FAD	C2A-N3A-C4A	3.65	120.74	111.83
3	E	502	MPD	CM-C2-C1	-3.48	102.84	110.63

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	504	FAD	C2A-N3A-C4A	3.44	120.22	111.83
4	F	505	FAD	C4A-N9A-C8A	3.41	109.32	105.74
4	E	505	FAD	O4B-C1B-C2B	-3.32	99.51	106.62
4	B	502	FAD	C4A-C5A-N7A	-3.31	106.80	110.58
4	E	505	FAD	N9A-C8A-N7A	-3.27	109.30	113.94
3	E	504	MPD	O2-C2-CM	3.25	118.12	107.99
4	A	504	FAD	O2A-PA-O1A	3.24	127.50	112.44
4	A	504	FAD	N9A-C8A-N7A	-3.19	109.42	113.94
4	A	504	FAD	C1'-C2'-C3'	-3.09	101.27	109.66
4	A	504	FAD	O5B-PA-O1A	-3.05	96.84	108.94
4	A	504	FAD	C4X-C10-N1	-3.03	117.16	124.59
4	E	505	FAD	C9A-C5X-N5	-2.99	119.28	122.45
4	A	504	FAD	C5A-C6A-N6A	-2.98	115.92	123.29
4	A	504	FAD	C5A-C4A-N9A	-2.96	102.59	105.81
4	B	502	FAD	C5X-C9A-N10	2.87	120.56	117.97
4	E	505	FAD	C5X-N5-C4X	2.76	122.55	118.09
4	A	504	FAD	O5'-C5'-C4'	-2.70	102.14	109.36
4	A	504	FAD	O2P-P-O1P	2.69	124.96	112.44
4	F	505	FAD	C4A-C5A-N7A	-2.67	107.53	110.58
4	A	504	FAD	O2A-PA-O5B	2.63	119.48	107.57
4	E	505	FAD	O5B-PA-O1A	-2.60	98.63	108.94
4	B	502	FAD	C1'-C2'-C3'	-2.60	102.61	109.66
4	B	502	FAD	C5B-C4B-C3B	-2.59	105.89	115.21
4	F	505	FAD	O3P-PA-O1A	-2.58	102.95	110.70
4	B	502	FAD	N9A-C8A-N7A	-2.58	110.28	113.94
4	F	505	FAD	O3'-C3'-C2'	-2.57	103.10	108.93
3	A	502	MPD	O2-C2-CM	-2.50	100.18	107.99
4	A	504	FAD	N6A-C6A-N1A	2.47	123.89	118.38
4	B	502	FAD	C1'-N10-C9A	2.43	125.35	120.63
4	B	502	FAD	C4X-C4-N3	2.42	119.42	113.25
4	E	505	FAD	N3-C2-N1	2.41	124.62	119.50
4	F	505	FAD	C6A-C5A-N7A	2.40	136.71	132.09
4	A	504	FAD	O3P-PA-O1A	2.39	117.90	110.70
3	E	502	MPD	O2-C2-C1	2.38	115.41	107.99
4	E	505	FAD	C5A-C6A-N6A	-2.37	117.41	123.29
4	A	504	FAD	C5X-N5-C4X	2.37	121.92	118.09
4	A	504	FAD	C4-C4X-N5	2.37	121.48	118.21
4	A	504	FAD	C4-N3-C2	-2.36	121.45	125.64
4	E	505	FAD	O3P-P-O1P	-2.35	103.64	110.70
4	B	502	FAD	C4-N3-C2	-2.33	121.51	125.64
4	B	502	FAD	C9A-N10-C10	-2.28	117.27	120.75
4	F	505	FAD	C5B-C4B-C3B	-2.27	107.05	115.21

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	504	FAD	O4-C4-C4X	-2.25	120.59	126.53
4	B	502	FAD	O2A-PA-O1A	2.25	122.89	112.44
4	F	505	FAD	C4X-C10-N1	-2.24	119.09	124.59
4	B	502	FAD	N3-C2-N1	2.24	124.26	119.50
4	F	505	FAD	O4B-C1B-C2B	-2.23	101.84	106.62
4	A	504	FAD	N3-C2-N1	2.23	124.24	119.50
4	E	505	FAD	C4X-C10-N1	-2.23	119.13	124.59
4	A	504	FAD	C4A-N9A-C1B	-2.21	121.46	126.63
4	E	505	FAD	C4A-N9A-C1B	-2.21	121.47	126.63
4	B	502	FAD	C4-C4X-N5	2.16	121.19	118.21
4	B	502	FAD	O2A-PA-O3P	-2.15	101.46	107.27
4	B	502	FAD	C9A-C5X-N5	-2.14	120.18	122.45
4	A	504	FAD	O2-C2-N1	-2.14	118.24	121.80
4	B	502	FAD	O3P-P-O1P	2.14	117.15	110.70
3	B	501	MPD	O4-C4-C5	-2.12	100.32	109.45
4	F	505	FAD	C5A-N7A-C8A	2.10	106.76	103.45
4	B	502	FAD	O5'-C5'-C4'	-2.09	103.78	109.36
4	E	505	FAD	C2A-N1A-C6A	2.09	122.16	118.73
4	E	505	FAD	C5X-C9A-N10	2.08	119.84	117.97
4	B	502	FAD	O3B-C3B-C2B	-2.07	105.17	111.82
4	F	505	FAD	O2A-PA-O1A	2.05	121.99	112.44
4	E	505	FAD	O2A-PA-O1A	2.04	121.95	112.44
3	F	503	MPD	C1-C2-C3	2.03	118.96	110.20
4	A	504	FAD	C10-C4X-N5	-2.03	120.67	124.81
4	B	502	FAD	C5'-C4'-C3'	-2.02	108.40	112.22

There are no chirality outliers.

All (33) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	E	502	MPD	C1-C2-C3-C4
3	E	502	MPD	O2-C2-C3-C4
4	E	505	FAD	PA-O3P-P-O5'
4	F	505	FAD	PA-O3P-P-O5'
4	A	504	FAD	C5B-O5B-PA-O2A
4	B	502	FAD	PA-O3P-P-O5'
4	A	504	FAD	O4B-C4B-C5B-O5B
4	A	504	FAD	C3B-C4B-C5B-O5B
4	F	505	FAD	P-O3P-PA-O1A
4	E	505	FAD	C3B-C4B-C5B-O5B
4	F	505	FAD	C3B-C4B-C5B-O5B
4	E	505	FAD	C2B-C1B-N9A-C8A

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Mol	Chain	Res	Type	Atoms
4	A	504	FAD	C2B-C1B-N9A-C8A
4	E	505	FAD	P-O3P-PA-O1A
3	E	504	MPD	C2-C3-C4-O4
3	E	502	MPD	CM-C2-C3-C4
3	F	504	MPD	CM-C2-C3-C4
3	E	504	MPD	C2-C3-C4-C5
3	F	504	MPD	C2-C3-C4-C5
4	F	505	FAD	P-O3P-PA-O2A
4	E	505	FAD	O4B-C4B-C5B-O5B
4	B	502	FAD	C3B-C4B-C5B-O5B
4	F	505	FAD	C2B-C1B-N9A-C8A
4	F	505	FAD	O4B-C4B-C5B-O5B
4	E	505	FAD	C2B-C1B-N9A-C4A
4	B	502	FAD	C2B-C1B-N9A-C8A
4	A	504	FAD	C2'-C3'-C4'-O4'
4	E	505	FAD	P-O3P-PA-O2A
4	B	502	FAD	O4B-C4B-C5B-O5B
4	A	504	FAD	O3'-C3'-C4'-C5'
4	A	504	FAD	C2B-C1B-N9A-C4A
4	A	504	FAD	O3'-C3'-C4'-O4'
4	B	502	FAD	P-O3P-PA-O2A

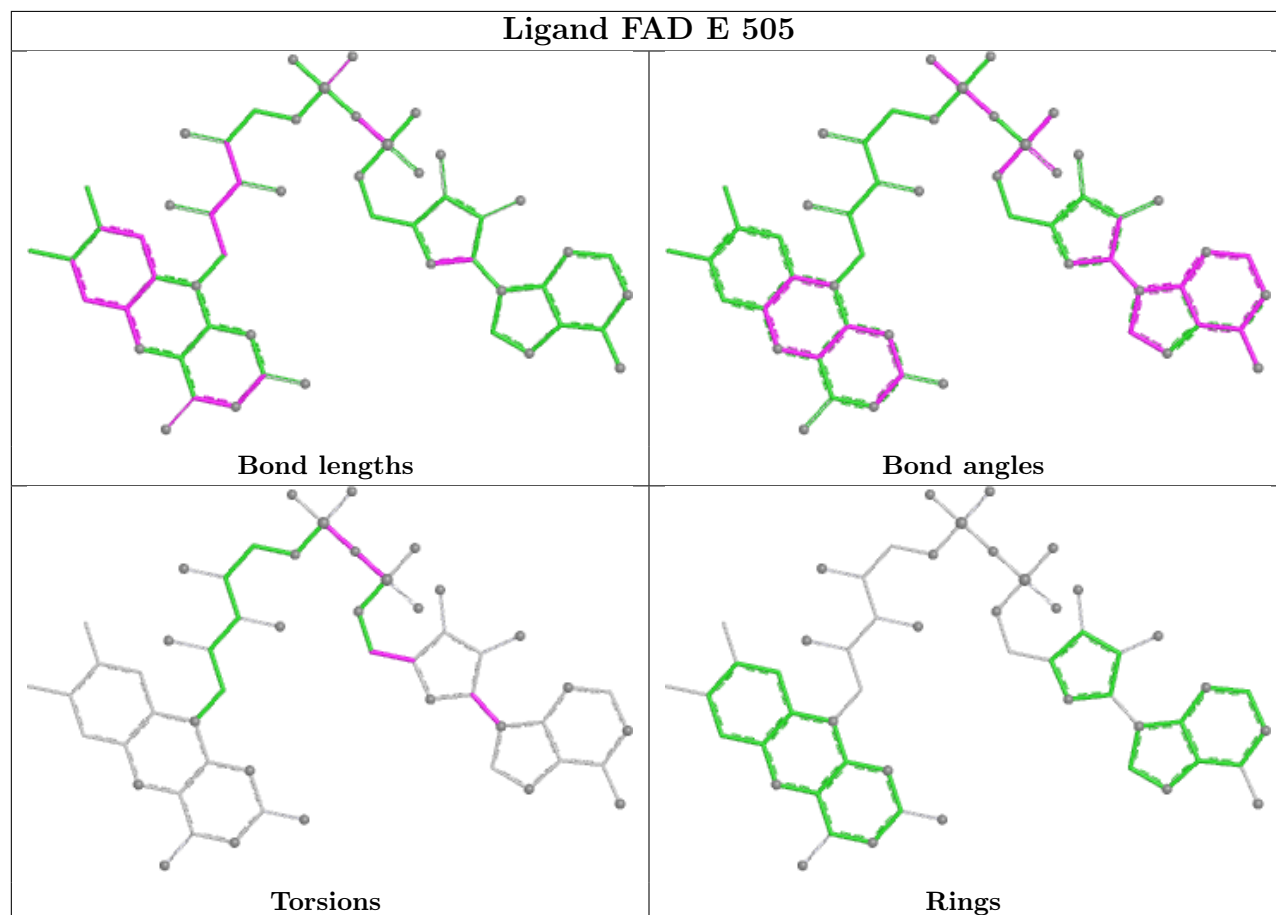
There are no ring outliers.

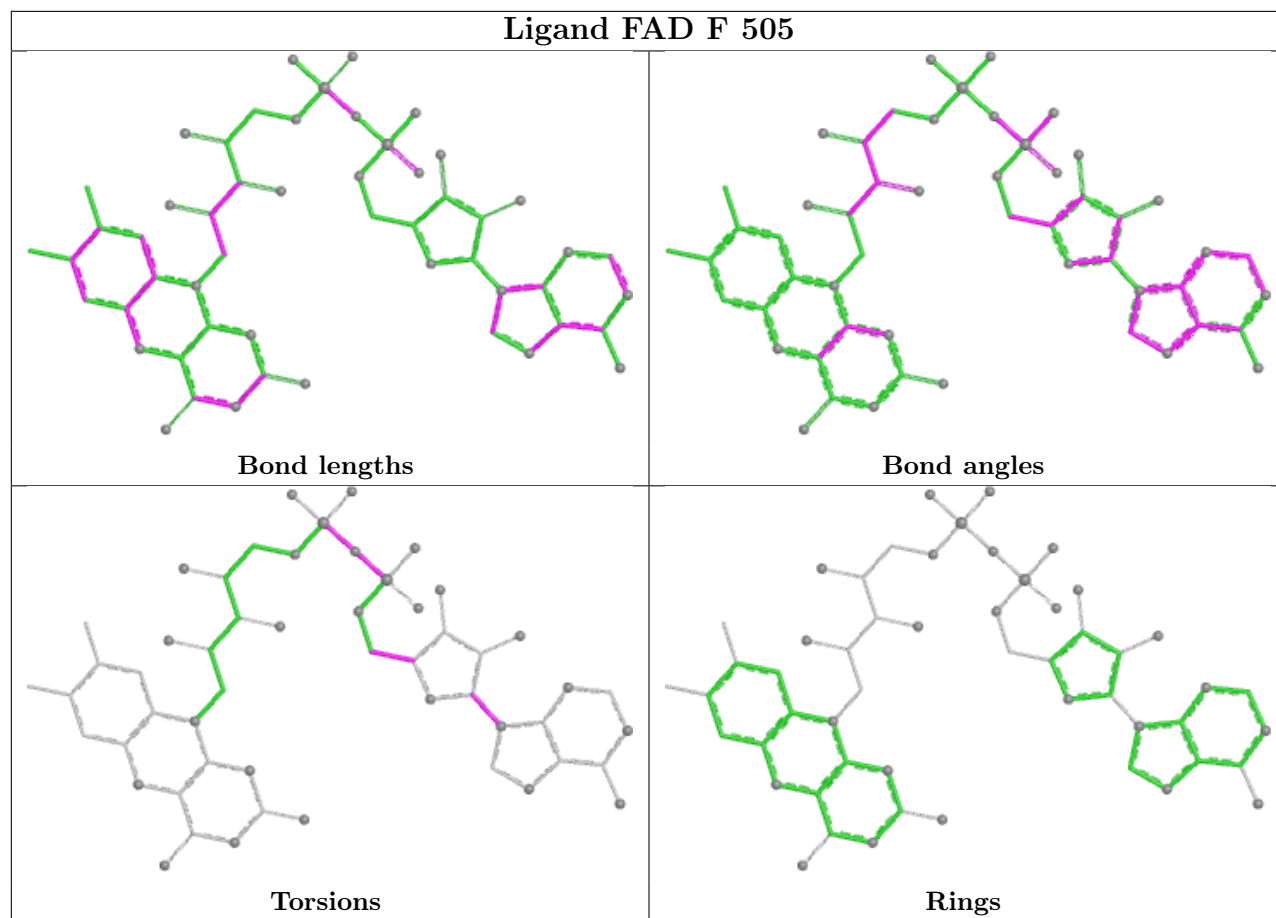
6 monomers are involved in 7 short contacts:

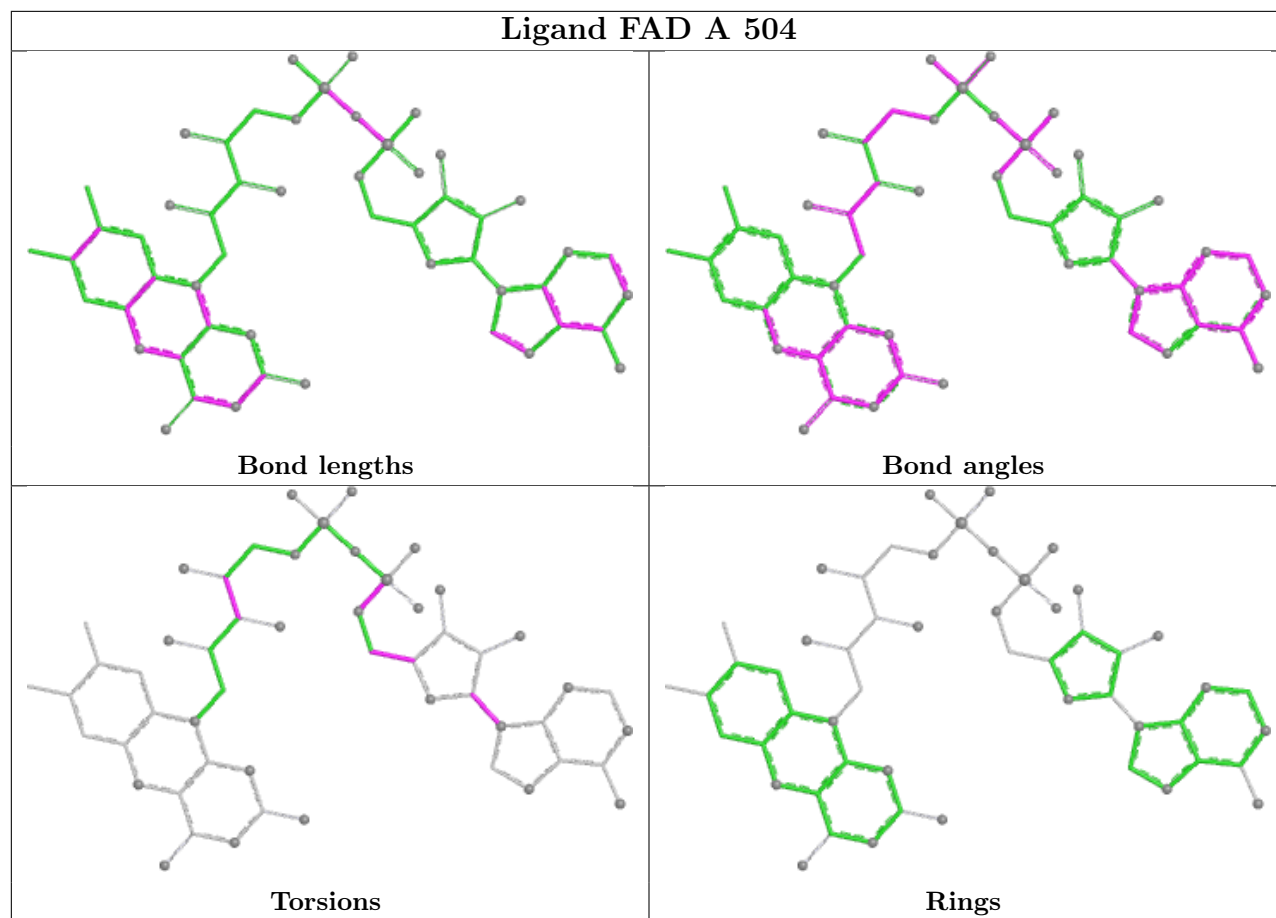
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	502	MPD	1	0
3	B	501	MPD	1	0
3	E	503	MPD	2	0
3	A	503	MPD	1	0
3	F	503	MPD	1	0
3	F	504	MPD	1	0

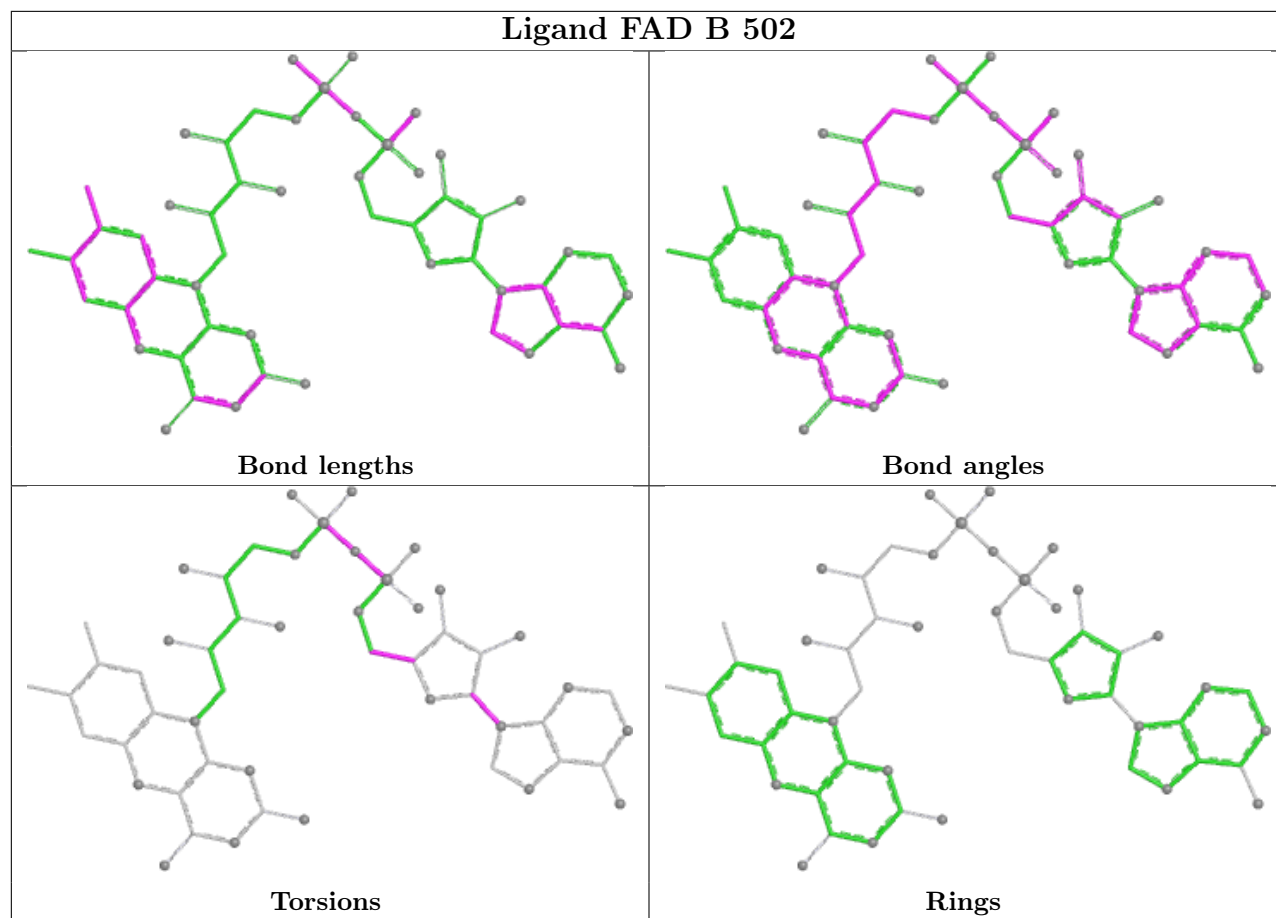
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. 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 ⓘ

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	484/499 (96%)	0.57	33 (6%)	23 20	35, 86, 133, 151	1 (0%)
1	B	484/499 (96%)	-0.27	8 (1%)	69 65	23, 50, 83, 129	5 (1%)
1	E	484/499 (96%)	-0.40	3 (0%)	85 83	29, 48, 78, 106	1 (0%)
1	F	485/499 (97%)	-0.44	6 (1%)	76 73	22, 43, 74, 131	6 (1%)
All	All	1937/1996 (97%)	-0.13	50 (2%)	57 53	22, 52, 114, 151	13 (0%)

All (50) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	493	LEU	5.4
1	F	493	LEU	4.8
1	A	306	GLY	4.2
1	A	279	THR	4.0
1	A	494	GLN	3.8
1	F	10	SER	3.5
1	E	493	LEU	3.4
1	F	93	THR	3.4
1	A	18	ILE	3.3
1	B	10	SER	3.3
1	A	493	LEU	3.2
1	A	154	ALA	3.0
1	A	139	LYS	2.9
1	A	308	LYS	2.8
1	E	10	SER	2.8
1	A	357	LEU	2.8
1	A	43	PHE	2.8
1	A	135	ILE	2.7
1	A	11	TYR	2.6
1	A	52	ARG	2.5
1	A	302	LEU	2.5

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Mol	Chain	Res	Type	RSRZ
1	A	146	LYS	2.5
1	A	41	LEU	2.5
1	A	319	THR	2.5
1	A	148	LYS	2.4
1	A	360	GLY	2.4
1	F	494	GLN	2.4
1	A	324	THR	2.4
1	B	430	LYS	2.4
1	A	93	THR	2.3
1	A	162	GLY	2.3
1	F	92	ASP	2.3
1	A	430	LYS	2.3
1	A	334	ASP	2.3
1	A	137	PRO	2.3
1	B	52	ARG	2.3
1	B	122	GLU	2.2
1	A	261	ALA	2.2
1	B	492	ILE	2.1
1	A	157	PHE	2.1
1	A	349	ALA	2.1
1	A	58	THR	2.1
1	F	52	ARG	2.1
1	A	358	TYR	2.1
1	A	150	LYS	2.1
1	B	114[A]	TRP	2.1
1	B	463	GLN	2.1
1	A	307	VAL	2.0
1	A	116	TYR	2.0
1	E	276	SER	2.0

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 oligosaccharides in this entry.

6.4 Ligands ⓘ

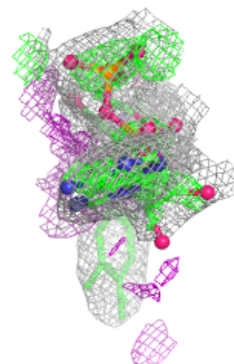
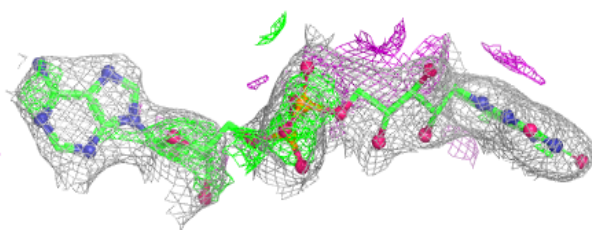
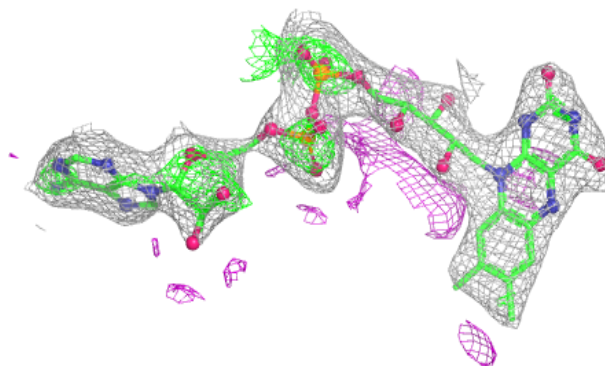
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
2	SO3	F	502	4/4	0.86	0.43	83,86,88,91	4
3	MPD	A	503	8/8	0.88	0.42	122,133,143,150	8
3	MPD	F	504	8/8	0.89	0.28	83,102,121,121	0
2	SO3	E	501	4/4	0.90	0.32	75,82,84,91	4
3	MPD	F	503	8/8	0.91	0.16	76,81,87,97	0
3	MPD	A	502	8/8	0.92	0.25	128,133,149,150	0
3	MPD	E	503	8/8	0.92	0.18	86,93,96,108	0
3	MPD	B	501	8/8	0.92	0.21	80,90,98,102	0
3	MPD	A	501	8/8	0.93	0.18	75,79,83,85	0
4	FAD	A	504	53/53	0.93	0.22	100,118,157,161	0
2	SO3	F	501	4/4	0.94	0.17	62,68,79,92	4
3	MPD	E	502	8/8	0.95	0.16	61,66,70,70	0
3	MPD	E	504	8/8	0.97	0.19	68,73,102,104	0
4	FAD	F	505	53/53	0.98	0.10	41,48,60,63	0
4	FAD	E	505	53/53	0.98	0.09	41,54,64,69	0
4	FAD	B	502	53/53	0.98	0.08	38,46,54,57	0

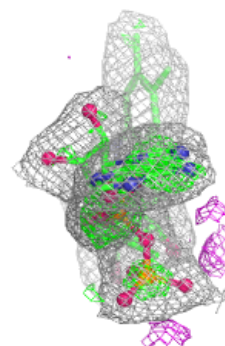
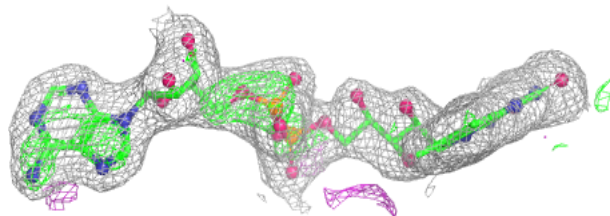
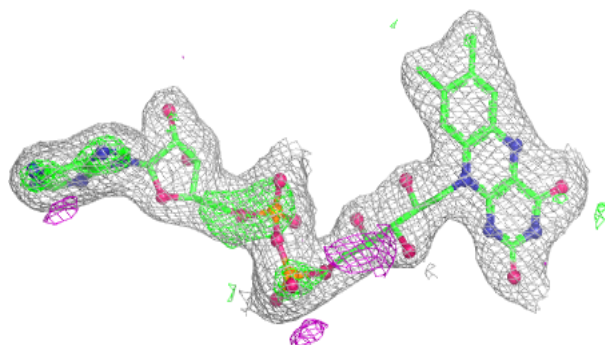
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around FAD A 504:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

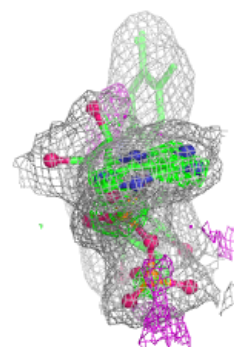
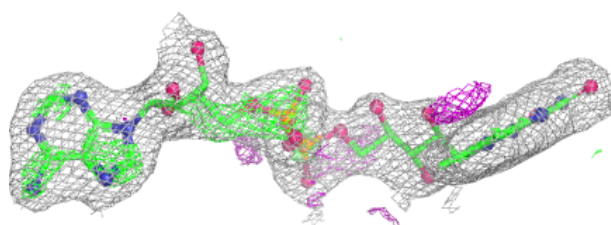
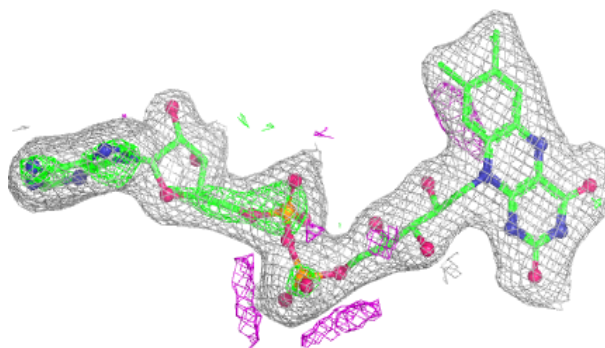
**Electron density around FAD F 505:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

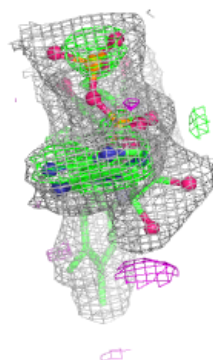
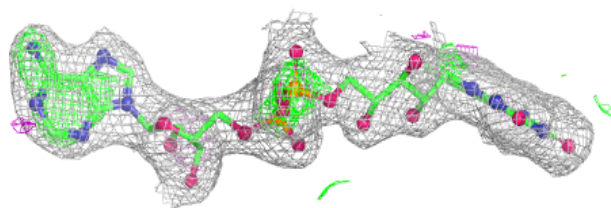
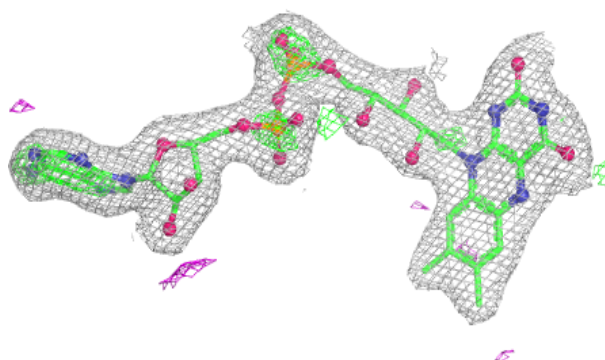


Electron density around FAD E 505:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

**Electron density around FAD B 502:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



6.5 Other polymers [i](#)

There are no such residues in this entry.