



Full wwPDB X-ray Structure Validation Report ⓘ

Sep 7, 2026 – 02:06 PM EDT

PDB ID : 9Y8Y / pdb_00009y8y
Title : CRYSTAL STRUCTURE OF SACCHAROMYCES CEREVISIAE ACETO-HYDROXYACID SYNTHASE IN COMPLEX WITH METHYL ACETYL PHOSPHONATE
Authors : Lonhienne, T.; Lin, X.; Guddat, W.L.
Deposited on : 2025-09-11
Resolution : 2.22 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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

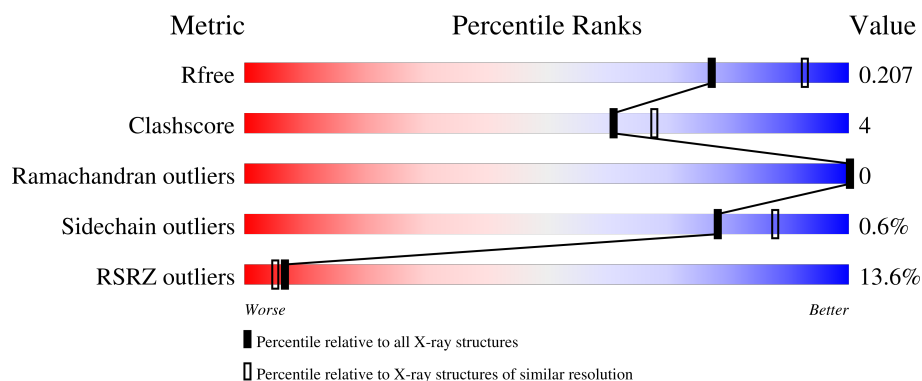
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.22 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	7682 (2.24-2.20)
Clashscore	190562	8402 (2.24-2.20)
Ramachandran outliers	187476	8303 (2.24-2.20)
Sidechain outliers	187428	8304 (2.24-2.20)
RSRZ outliers	180081	7683 (2.24-2.20)

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	677	 6% 74% 6% 19%
1	B	677	 16% 71% 10% 19%

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 17225 atoms, of which 8172 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 Acetolactate synthase catalytic subunit, mitochondrial.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	548	Total	C	H	N	O	S	0	1	0
			8213	2640	4048	715	789	21			
1	B	551	Total	C	H	N	O	S	0	0	0
			8252	2634	4088	718	792	20			

There are 94 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	11	MET	-	expression tag	UNP P07342
A	12	HIS	-	expression tag	UNP P07342
A	13	HIS	-	expression tag	UNP P07342
A	14	HIS	-	expression tag	UNP P07342
A	15	HIS	-	expression tag	UNP P07342
A	16	HIS	-	expression tag	UNP P07342
A	17	HIS	-	expression tag	UNP P07342
A	18	SER	-	expression tag	UNP P07342
A	19	SER	-	expression tag	UNP P07342
A	20	GLY	-	expression tag	UNP P07342
A	21	LEU	-	expression tag	UNP P07342
A	22	VAL	-	expression tag	UNP P07342
A	23	PRO	-	expression tag	UNP P07342
A	24	ARG	-	expression tag	UNP P07342
A	25	GLY	-	expression tag	UNP P07342
A	26	SER	-	expression tag	UNP P07342
A	27	GLY	-	expression tag	UNP P07342
A	28	MET	-	expression tag	UNP P07342
A	29	LYS	-	expression tag	UNP P07342
A	30	GLU	-	expression tag	UNP P07342
A	31	THR	-	expression tag	UNP P07342
A	32	ALA	-	expression tag	UNP P07342
A	33	ALA	-	expression tag	UNP P07342
A	34	ALA	-	expression tag	UNP P07342
A	35	LYS	-	expression tag	UNP P07342

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
A	36	PHE	-	expression tag	UNP P07342
A	37	GLU	-	expression tag	UNP P07342
A	38	ARG	-	expression tag	UNP P07342
A	39	GLN	-	expression tag	UNP P07342
A	40	HIS	-	expression tag	UNP P07342
A	41	MET	-	expression tag	UNP P07342
A	42	ASP	-	expression tag	UNP P07342
A	43	SER	-	expression tag	UNP P07342
A	44	PRO	-	expression tag	UNP P07342
A	45	ASP	-	expression tag	UNP P07342
A	46	LEU	-	expression tag	UNP P07342
A	47	GLY	-	expression tag	UNP P07342
A	48	THR	-	expression tag	UNP P07342
A	49	ASP	-	expression tag	UNP P07342
A	50	ASP	-	expression tag	UNP P07342
A	51	ASP	-	expression tag	UNP P07342
A	52	ASP	-	expression tag	UNP P07342
A	53	LYS	-	expression tag	UNP P07342
A	54	ALA	-	expression tag	UNP P07342
A	55	MET	-	expression tag	UNP P07342
A	56	GLY	-	expression tag	UNP P07342
A	57	SER	-	expression tag	UNP P07342
B	11	MET	-	expression tag	UNP P07342
B	12	HIS	-	expression tag	UNP P07342
B	13	HIS	-	expression tag	UNP P07342
B	14	HIS	-	expression tag	UNP P07342
B	15	HIS	-	expression tag	UNP P07342
B	16	HIS	-	expression tag	UNP P07342
B	17	HIS	-	expression tag	UNP P07342
B	18	SER	-	expression tag	UNP P07342
B	19	SER	-	expression tag	UNP P07342
B	20	GLY	-	expression tag	UNP P07342
B	21	LEU	-	expression tag	UNP P07342
B	22	VAL	-	expression tag	UNP P07342
B	23	PRO	-	expression tag	UNP P07342
B	24	ARG	-	expression tag	UNP P07342
B	25	GLY	-	expression tag	UNP P07342
B	26	SER	-	expression tag	UNP P07342
B	27	GLY	-	expression tag	UNP P07342
B	28	MET	-	expression tag	UNP P07342
B	29	LYS	-	expression tag	UNP P07342
B	30	GLU	-	expression tag	UNP P07342

Continued on next page...

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
B	31	THR	-	expression tag	UNP P07342
B	32	ALA	-	expression tag	UNP P07342
B	33	ALA	-	expression tag	UNP P07342
B	34	ALA	-	expression tag	UNP P07342
B	35	LYS	-	expression tag	UNP P07342
B	36	PHE	-	expression tag	UNP P07342
B	37	GLU	-	expression tag	UNP P07342
B	38	ARG	-	expression tag	UNP P07342
B	39	GLN	-	expression tag	UNP P07342
B	40	HIS	-	expression tag	UNP P07342
B	41	MET	-	expression tag	UNP P07342
B	42	ASP	-	expression tag	UNP P07342
B	43	SER	-	expression tag	UNP P07342
B	44	PRO	-	expression tag	UNP P07342
B	45	ASP	-	expression tag	UNP P07342
B	46	LEU	-	expression tag	UNP P07342
B	47	GLY	-	expression tag	UNP P07342
B	48	THR	-	expression tag	UNP P07342
B	49	ASP	-	expression tag	UNP P07342
B	50	ASP	-	expression tag	UNP P07342
B	51	ASP	-	expression tag	UNP P07342
B	52	ASP	-	expression tag	UNP P07342
B	53	LYS	-	expression tag	UNP P07342
B	54	ALA	-	expression tag	UNP P07342
B	55	MET	-	expression tag	UNP P07342
B	56	GLY	-	expression tag	UNP P07342
B	57	SER	-	expression tag	UNP P07342

- Molecule 2 is POTASSIUM ION (CCD ID: K) (formula: K).

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

- Molecule 3 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

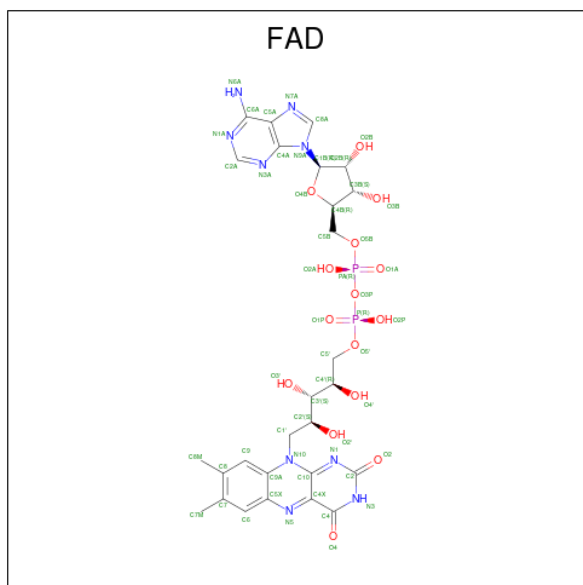
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total Mg 1 1	0	0

Continued on next page...

Continued from previous page...

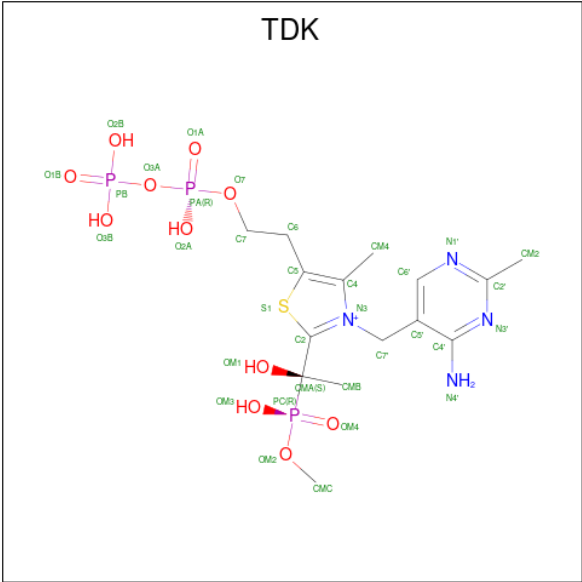
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	1	Total	Mg	0	0
			1	1		

- Molecule 4 is FLAVIN-ADENINE DINUCLEOTIDE (CCD ID: FAD) (formula: $C_{27}H_{33}N_9O_{15}P_2$) (labeled as "Ligand of Interest" by depositor).



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

- Molecule 5 is 3-[(4-AMINO-2-METHYLPYRIMIDIN-5-YL)METHYL]-2-[(1S)-1-HYDROXY-1-[(R)-HYDROXY(METHOXY)PHOSPHORYL]ETHYL]-5-(2-[(S)-HYDROXY(PHOSPHONOXY)PHOSPHORYL]OXY)ETHYL)-4-METHYL-1,3-THIAZOL-3-IUM (CCD ID: TDK) (formula: $C_{15}H_{26}N_4O_{11}P_3S$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms							ZeroOcc	AltConf
5	A	1	Total	C	H	N	O	P	S	0	0
			52	15	18	4	11	3	1		
5	B	1	Total	C	H	N	O	P	S	0	0
			52	15	18	4	11	3	1		

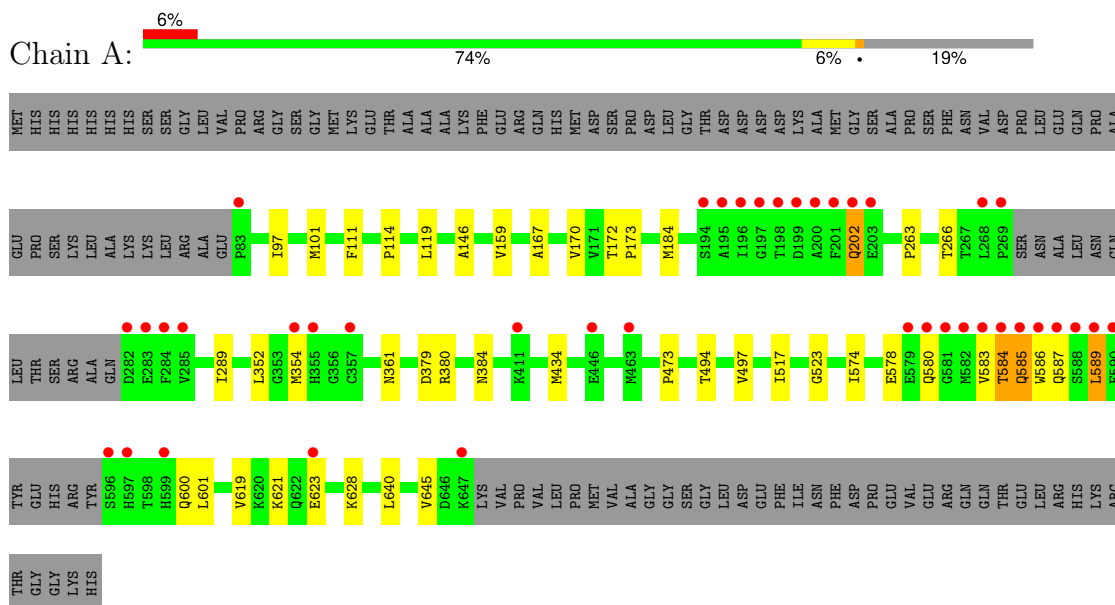
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	333	Total	O	0	0
			333	333		
6	B	213	Total	O	0	0
			213	213		

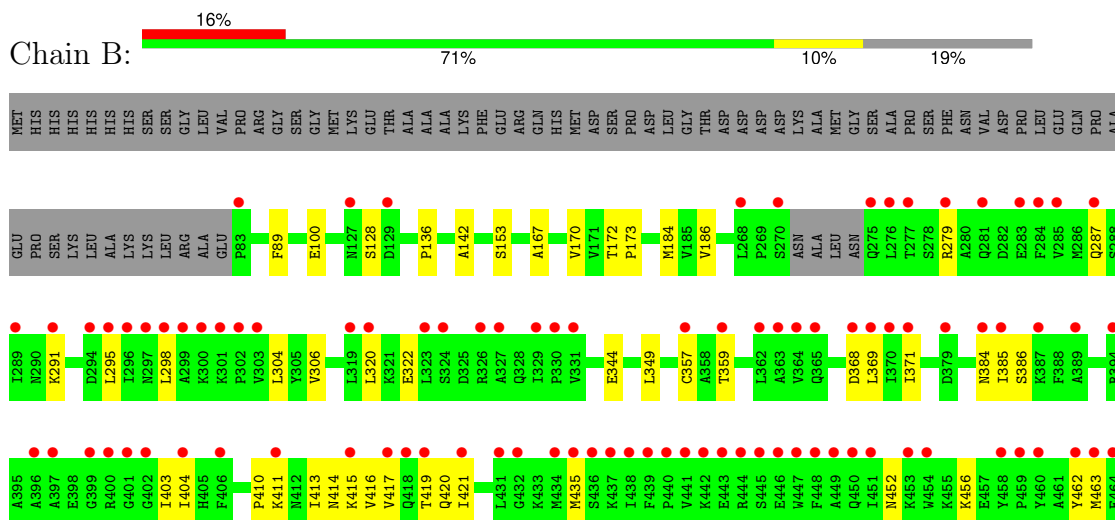
3 Residue-property plots

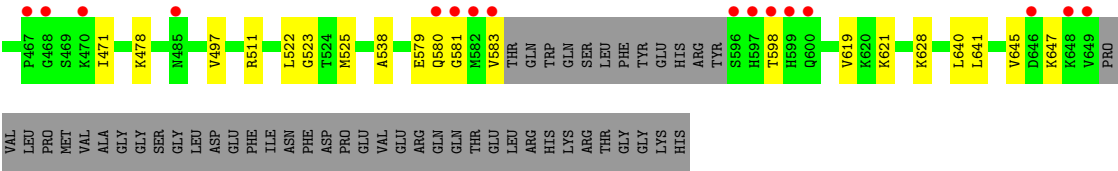
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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: Acetolactate synthase catalytic subunit, mitochondrial



- Molecule 1: Acetolactate synthase catalytic subunit, mitochondrial





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	95.61Å 109.66Å 179.86Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.81 – 2.22 47.81 – 2.22	Depositor EDS
% Data completeness (in resolution range)	96.7 (47.81-2.22) 96.7 (47.81-2.22)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.65 (at 2.22Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.176 , 0.209 0.175 , 0.207	Depositor DCC
R_{free} test set	2000 reflections (2.14%)	wwPDB-VP
Wilson B-factor (Å ²)	33.9	Xtriage
Anisotropy	0.192	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.42 , 49.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	17225	wwPDB-VP
Average B, all atoms (Å ²)	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.88% 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: TDK, MG, K, 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	0.23	0/4249	0.36	0/5764
1	B	0.20	0/4245	0.35	0/5759
All	All	0.22	0/8494	0.36	0/11523

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 [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	4165	4048	4188	29	0
1	B	4164	4088	4188	45	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	53	0	31	0	0
4	B	53	0	31	0	0
5	A	34	18	21	0	0
5	B	34	18	21	1	0
6	A	333	0	0	2	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	B	213	0	0	1	0
All	All	9053	8172	8480	71	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.

All (71) 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:119:LEU:HD11	1:B:583:VAL:HG13	1.78	0.65
1:A:586:TRP:HB2	1:A:587:GLN:HE21	1.62	0.64
1:A:585:GLN:HG2	6:A:1035:HOH:O	1.98	0.62
1:A:583:VAL:HG22	1:A:589:LEU:HD23	1.82	0.61
1:B:525:MET:SD	5:B:704:TDK:HM42	2.44	0.58
1:B:463:MET:HA	1:B:463:MET:HE3	1.86	0.57
1:B:304:LEU:HD23	1:B:371:ILE:HB	1.89	0.55
1:A:621:LYS:HE2	1:A:623:GLU:OE2	2.07	0.54
1:B:420:GLN:C	1:B:421:ILE:HD12	2.34	0.53
1:B:369:LEU:HD11	1:B:404:ILE:HG13	1.91	0.53
1:A:583:VAL:HG22	1:A:589:LEU:CD2	2.41	0.51
1:A:202:GLN:NE2	1:B:522:LEU:O	2.44	0.51
1:A:354:MET:HE1	1:A:380:ARG:HH11	1.76	0.50
1:B:368:ASP:OD1	1:B:369:LEU:N	2.45	0.50
1:B:619:VAL:HG22	1:B:628:LYS:HG3	1.94	0.50
1:B:403:ILE:HD13	1:B:417:VAL:HG11	1.95	0.49
1:B:295:LEU:HD22	1:B:369:LEU:HD13	1.95	0.49
1:B:349:LEU:HD22	1:B:359:THR:HG22	1.94	0.49
1:A:578:GLU:OE2	1:A:600:GLN:O	2.31	0.48
1:B:414:ASN:ND2	1:B:419:THR:HG22	2.29	0.48
1:A:289:ILE:HG23	1:A:434:MET:HB2	1.96	0.47
1:A:114:PRO:HG3	1:B:598:THR:HG21	1.97	0.47
1:B:167:ALA:O	1:B:170:VAL:HG22	2.14	0.47
1:B:298:LEU:C	1:B:298:LEU:HD23	2.39	0.47
1:B:456:LYS:HD3	1:B:456:LYS:H	1.80	0.47
1:A:619:VAL:HG22	1:A:628:LYS:HG3	1.97	0.46
1:B:287:GLN:HG3	1:B:291:LYS:NZ	2.31	0.46
1:B:619:VAL:HG23	1:B:641:LEU:HD11	1.97	0.46
1:A:146:ALA:HB3	1:A:184:MET:HE2	1.98	0.45
1:B:136:PRO:HG3	1:B:142:ALA:HB2	1.97	0.45
1:B:580:GLN:HG2	1:B:581:GLY:H	1.80	0.45
1:A:172:THR:HB	1:A:173:PRO:HD3	1.97	0.45

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:579:GLU:HG3	1:B:647:LYS:HE3	1.98	0.45
1:B:420:GLN:HB3	1:B:421:ILE:HD12	1.98	0.45
1:B:416:VAL:HG12	1:B:417:VAL:HG23	1.99	0.45
1:B:421:ILE:HD12	1:B:421:ILE:N	2.32	0.45
1:B:462:TYR:OH	1:B:478:LYS:NZ	2.48	0.44
1:B:279:ARG:HH11	1:B:279:ARG:HG3	1.82	0.44
1:A:494:THR:HA	1:A:517:ILE:O	2.19	0.43
1:A:111:PHE:O	1:A:159:VAL:HA	2.19	0.43
1:B:89:PHE:HE1	1:B:100:GLU:HG2	1.83	0.43
1:A:473:PRO:HD3	1:A:645:VAL:HG13	2.01	0.42
1:A:167:ALA:O	1:A:170:VAL:HG22	2.20	0.42
1:A:263:PRO:HB2	1:A:266:THR:HG23	2.01	0.42
1:B:344:GLU:HG3	1:B:511:ARG:NE	2.34	0.42
1:B:411:LYS:O	1:B:415:LYS:HD3	2.18	0.42
1:B:357:CYS:SG	1:B:359:THR:HB	2.59	0.42
1:A:354:MET:CE	1:A:380:ARG:HH11	2.32	0.42
1:B:497:VAL:HG21	1:B:523:GLY:C	2.44	0.42
1:A:497:VAL:HG21	1:A:523:GLY:C	2.45	0.42
1:A:580:GLN:HE22	1:A:601:LEU:HA	1.84	0.42
1:A:584:THR:OG1	1:A:587:GLN:HG2	2.19	0.42
1:A:97:ILE:O	1:A:101:MET:HG2	2.20	0.41
1:B:645:VAL:O	1:B:647:LYS:HE2	2.20	0.41
1:B:306:VAL:HG21	1:B:320:LEU:HD21	2.02	0.41
1:B:640:LEU:C	1:B:640:LEU:HD23	2.45	0.41
1:B:153:SER:HB3	1:B:538:ALA:HB1	2.03	0.41
1:A:379:ASP:OD1	1:A:379:ASP:C	2.63	0.41
1:B:384:ASN:O	1:B:385:ILE:HB	2.21	0.41
1:B:452:ASN:O	1:B:456:LYS:HD3	2.20	0.41
1:B:456:LYS:HD3	1:B:456:LYS:N	2.35	0.41
1:B:172:THR:HB	1:B:173:PRO:HD3	2.03	0.41
1:A:574:ILE:CD1	1:A:640:LEU:HD11	2.50	0.41
1:B:184:MET:HE3	1:B:186:VAL:CG2	2.51	0.41
1:B:410:PRO:HA	1:B:413:ILE:HD12	2.02	0.41
1:A:585:GLN:HG3	1:A:586:TRP:CZ3	2.56	0.40
1:B:128:SER:N	6:B:819:HOH:O	2.54	0.40
1:B:322:GLU:HB3	1:B:435:MET:HE3	2.03	0.40
1:A:384:ASN:ND2	6:A:820:HOH:O	2.55	0.40
1:A:352:LEU:HD12	1:A:361:ASN:OD1	2.21	0.40
1:B:471:ILE:HD11	1:B:621:LYS:C	2.47	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	543/677 (80%)	532 (98%)	11 (2%)	0	100	100
1	B	545/677 (80%)	533 (98%)	12 (2%)	0	100	100
All	All	1088/1354 (80%)	1065 (98%)	23 (2%)	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	449/556 (81%)	445 (99%)	4 (1%)	70	82
1	B	448/556 (81%)	447 (100%)	1 (0%)	87	94
All	All	897/1112 (81%)	892 (99%)	5 (1%)	78	88

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	202	GLN
1	A	584	THR
1	A	585	GLN
1	A	589	LEU
1	B	386	SER

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

Mol	Chain	Res	Type
1	A	418	GLN
1	A	485	ASN
1	A	554	ASN
1	A	587	GLN
1	A	597	HIS
1	B	366	ASN
1	B	384	ASN
1	B	414	ASN
1	B	418	GLN
1	B	622	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 8 ligands modelled in this entry, 4 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	$\# Z > 2$
5	TDK	B	704	3	31,35,35	3.09	7 (22%)	41,55,55	2.01	17 (41%)
5	TDK	A	704	3	31,35,35	3.15	7 (22%)	41,55,55	2.08	16 (39%)
4	FAD	A	703	-	58,58,58	1.46	10 (17%)	85,89,89	1.50	13 (15%)
4	FAD	B	703	-	58,58,58	0.85	0	85,89,89	0.75	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
5	TDK	B	704	3	-	4/28/35/35	0/2/2/2
5	TDK	A	704	3	-	3/28/35/35	0/2/2/2
4	FAD	A	703	-	-	5/34/50/50	0/6/6/6
4	FAD	B	703	-	-	4/34/50/50	0/6/6/6

All (24) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	704	TDK	C4-N3	11.81	1.55	1.40
5	B	704	TDK	C4-N3	11.05	1.54	1.40
5	B	704	TDK	OM1-CMA	-8.95	1.23	1.43
5	A	704	TDK	OM1-CMA	-8.90	1.23	1.43
5	A	704	TDK	C5-C4	5.65	1.47	1.35
5	B	704	TDK	C5-C4	5.62	1.47	1.35
4	A	703	FAD	C9A-C5X	4.74	1.48	1.41
4	A	703	FAD	C5A-C4A	3.92	1.46	1.39
5	B	704	TDK	C4'-N4'	3.76	1.43	1.34
5	A	704	TDK	C4'-N4'	3.70	1.43	1.34
4	A	703	FAD	C8-C7	3.28	1.48	1.40
4	A	703	FAD	C4-N3	-3.22	1.32	1.38
5	B	704	TDK	PA-O3A	-3.18	1.56	1.59
5	B	704	TDK	PC-OM3	-3.10	1.50	1.56
5	A	704	TDK	PC-OM3	-3.09	1.50	1.56
4	A	703	FAD	C5A-N7A	-2.99	1.33	1.39
5	A	704	TDK	PA-O3A	-2.84	1.56	1.59
4	A	703	FAD	C4A-N9A	-2.61	1.32	1.37
4	A	703	FAD	C5X-N5	-2.58	1.34	1.39
4	A	703	FAD	C2-N3	-2.57	1.33	1.39
5	B	704	TDK	PC-CMA	2.33	1.87	1.84
4	A	703	FAD	C8A-N9A	-2.24	1.33	1.37
4	A	703	FAD	C5A-C6A	2.21	1.47	1.41
5	A	704	TDK	PC-CMA	2.06	1.87	1.84

All (46) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	703	FAD	C5A-C4A-N3A	-4.95	119.91	126.72
5	A	704	TDK	N1'-C2'-N3'	-4.38	118.23	125.53

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	703	FAD	N3A-C4A-N9A	4.38	134.62	127.17
5	B	704	TDK	N1'-C2'-N3'	-4.30	118.37	125.53
5	A	704	TDK	S1-C2-N3	-4.24	108.09	112.24
5	A	704	TDK	CM2-C2'-N1'	3.98	121.43	117.20
5	A	704	TDK	OM3-PC-OM4	-3.69	101.89	111.17
4	A	703	FAD	N3A-C2A-N1A	-3.62	123.11	128.58
5	B	704	TDK	S1-C2-N3	-3.62	108.69	112.24
4	A	703	FAD	C4A-N9A-C8A	3.57	109.49	105.74
5	B	704	TDK	CM2-C2'-N1'	3.55	120.98	117.20
4	A	703	FAD	C2A-N3A-C4A	3.45	120.26	111.83
5	B	704	TDK	OM3-PC-OM4	-3.28	102.90	111.17
5	A	704	TDK	CM4-C4-N3	3.26	126.21	121.95
5	B	704	TDK	C6-C5-S1	3.19	126.14	119.29
5	A	704	TDK	O2B-PB-O3A	3.16	115.22	104.64
5	A	704	TDK	CMA-C2-S1	3.11	125.28	120.48
4	A	703	FAD	C4A-C5A-N7A	-3.01	107.14	110.58
5	A	704	TDK	O3B-PB-O3A	2.98	114.61	104.64
5	B	704	TDK	CM4-C4-N3	2.95	125.81	121.95
5	B	704	TDK	O3B-PB-O3A	2.90	114.38	104.64
5	B	704	TDK	O2B-PB-O3A	2.79	113.98	104.64
5	A	704	TDK	C6-C5-S1	2.72	125.13	119.29
5	B	704	TDK	CMA-C2-S1	2.68	124.63	120.48
5	B	704	TDK	C6'-N1'-C2'	2.66	120.44	116.07
4	A	703	FAD	C4-C4X-N5	2.66	121.88	118.21
5	B	704	TDK	PC-CMA-OM1	2.63	112.12	105.64
5	B	704	TDK	OM2-PC-OM4	-2.62	108.94	114.62
5	A	704	TDK	C6'-N1'-C2'	2.60	120.34	116.07
5	A	704	TDK	PC-CMA-OM1	2.55	111.93	105.64
5	A	704	TDK	OM3-PC-CMA	2.54	111.98	106.62
4	A	703	FAD	C5A-N7A-C8A	2.48	107.35	103.45
5	A	704	TDK	C4-C5-S1	-2.41	108.07	110.56
4	A	703	FAD	N9A-C8A-N7A	-2.40	110.54	113.94
5	B	704	TDK	CM2-C2'-N3'	2.35	120.65	117.13
4	A	703	FAD	C2A-N1A-C6A	2.34	122.57	118.73
5	B	704	TDK	O2A-PA-O1A	-2.24	102.00	112.44
5	B	704	TDK	C7'-N3-C4	-2.23	120.22	123.95
5	A	704	TDK	C2'-N3'-C4'	2.20	121.48	118.10
5	A	704	TDK	O2A-PA-O1A	-2.17	102.36	112.44
5	A	704	TDK	CM2-C2'-N3'	2.14	120.33	117.13
4	A	703	FAD	C4X-C10-N1	-2.13	119.36	124.59
4	A	703	FAD	C6A-C5A-N7A	2.10	136.13	132.09
4	A	703	FAD	C5X-C9A-N10	2.09	119.86	117.97

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	704	TDK	C2'-N3'-C4'	2.07	121.28	118.10
5	B	704	TDK	O2A-PA-O3A	2.02	112.73	107.27

There are no chirality outliers.

All (16) torsion outliers are listed below:

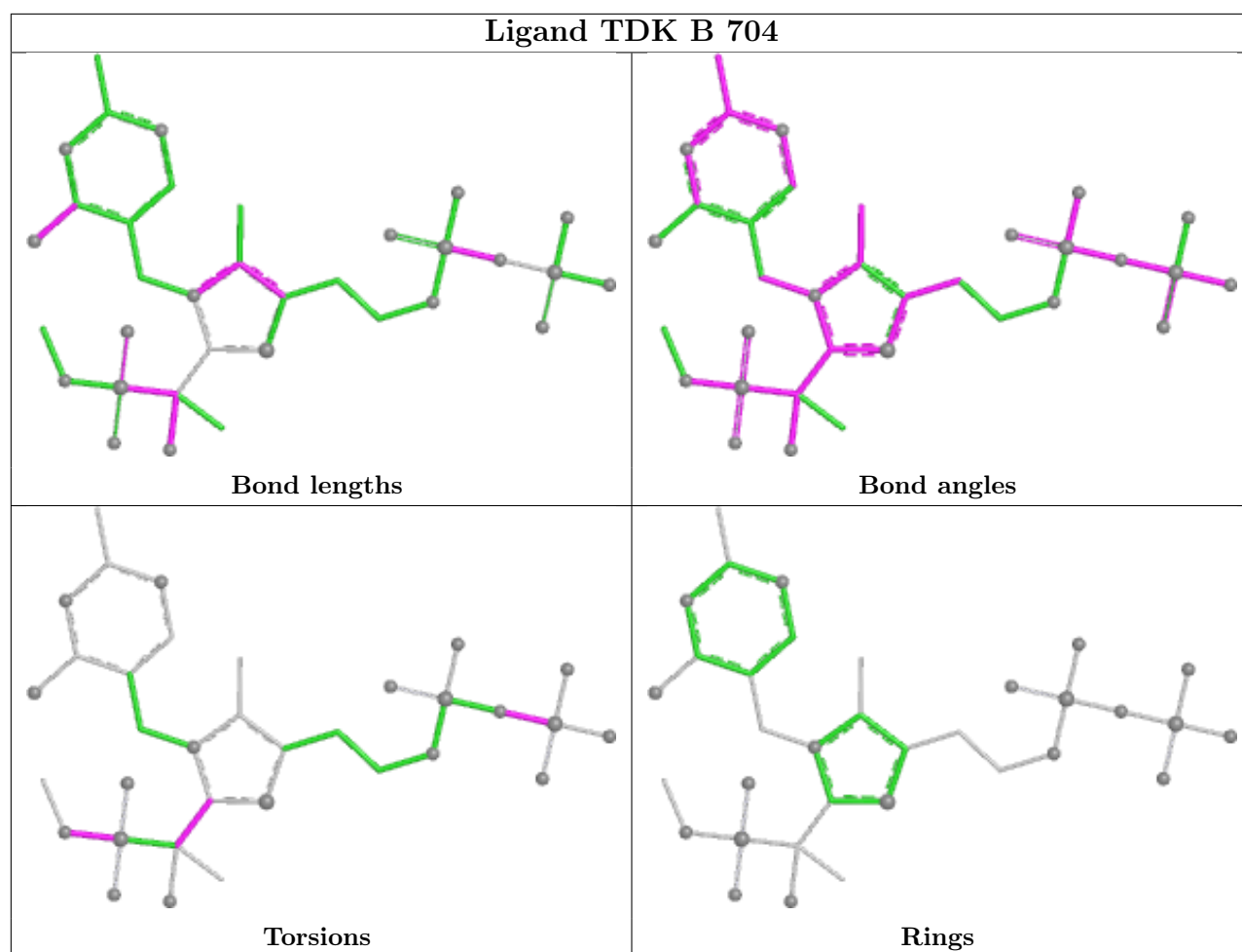
Mol	Chain	Res	Type	Atoms
5	A	704	TDK	S1-C2-CMA-OM1
5	B	704	TDK	S1-C2-CMA-OM1
5	A	704	TDK	CMC-OM2-PC-OM4
5	B	704	TDK	CMC-OM2-PC-OM4
5	A	704	TDK	PA-O3A-PB-O1B
5	B	704	TDK	PA-O3A-PB-O1B
4	A	703	FAD	P-O3P-PA-O5B
4	A	703	FAD	C2B-C1B-N9A-C8A
4	B	703	FAD	C2B-C1B-N9A-C8A
4	B	703	FAD	PA-O3P-P-O1P
4	B	703	FAD	PA-O3P-P-O2P
5	B	704	TDK	PA-O3A-PB-O3B
4	A	703	FAD	O4B-C1B-N9A-C8A
4	A	703	FAD	PA-O3P-P-O2P
4	B	703	FAD	O4B-C1B-N9A-C8A
4	A	703	FAD	O4B-C4B-C5B-O5B

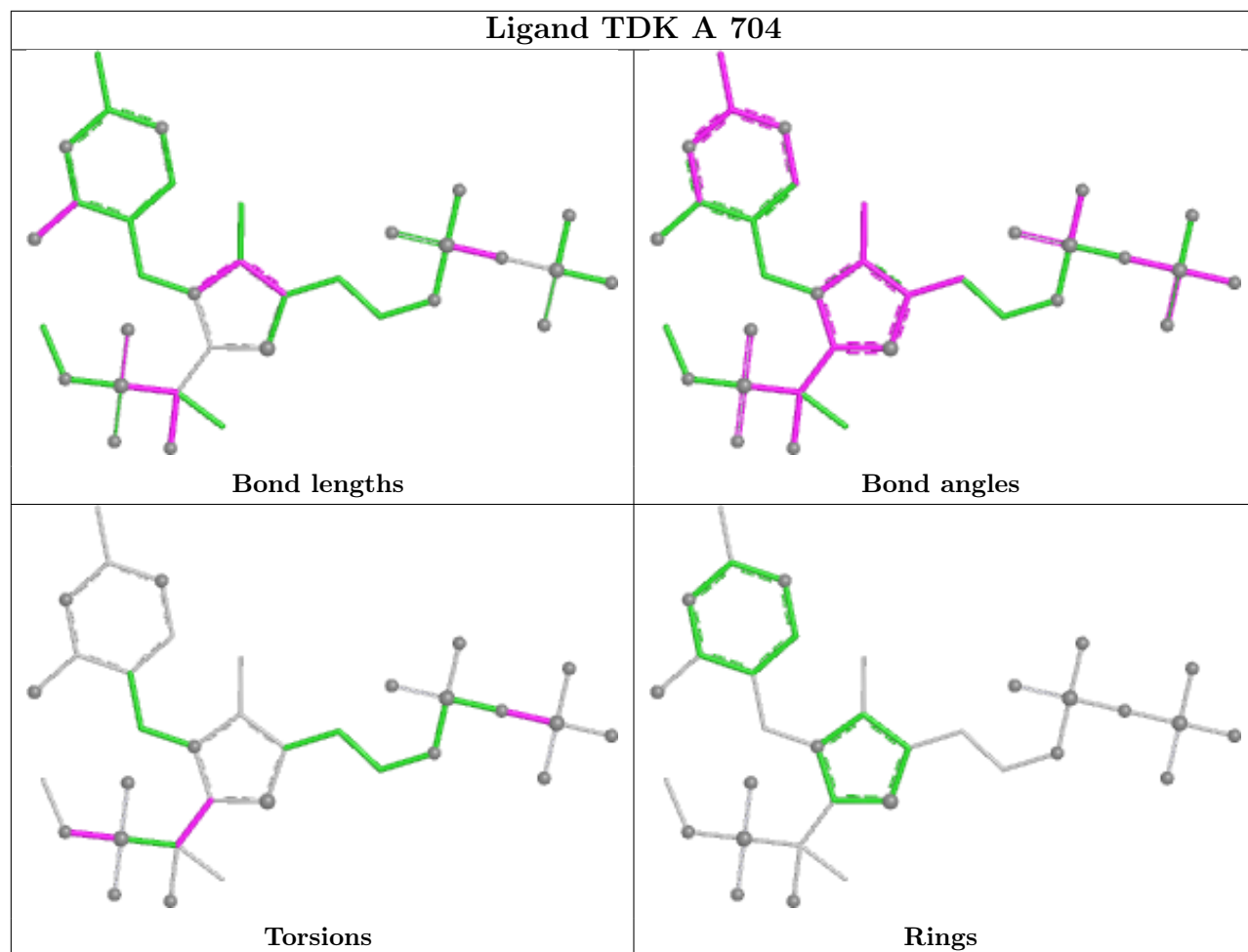
There are no ring outliers.

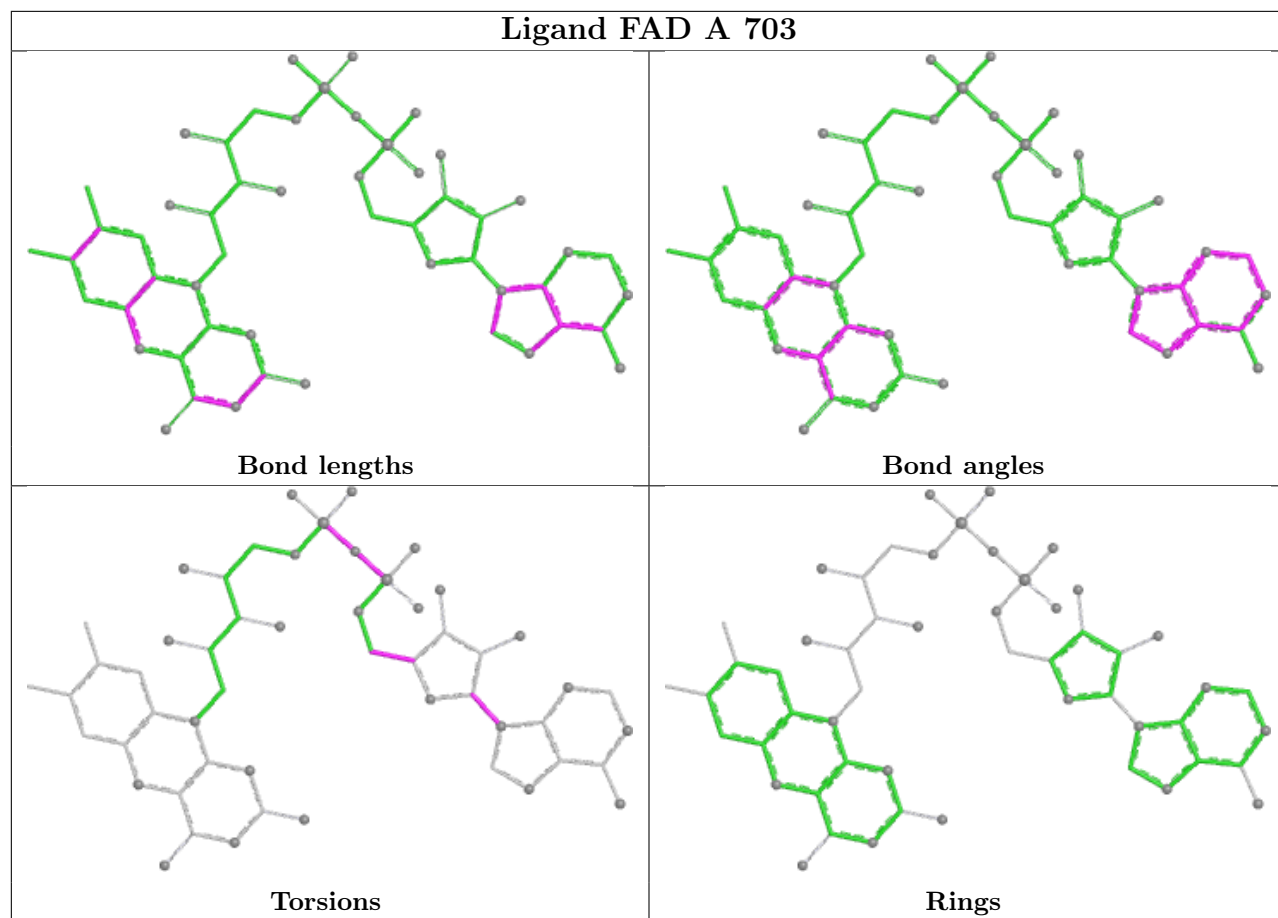
1 monomer is involved in 1 short contact:

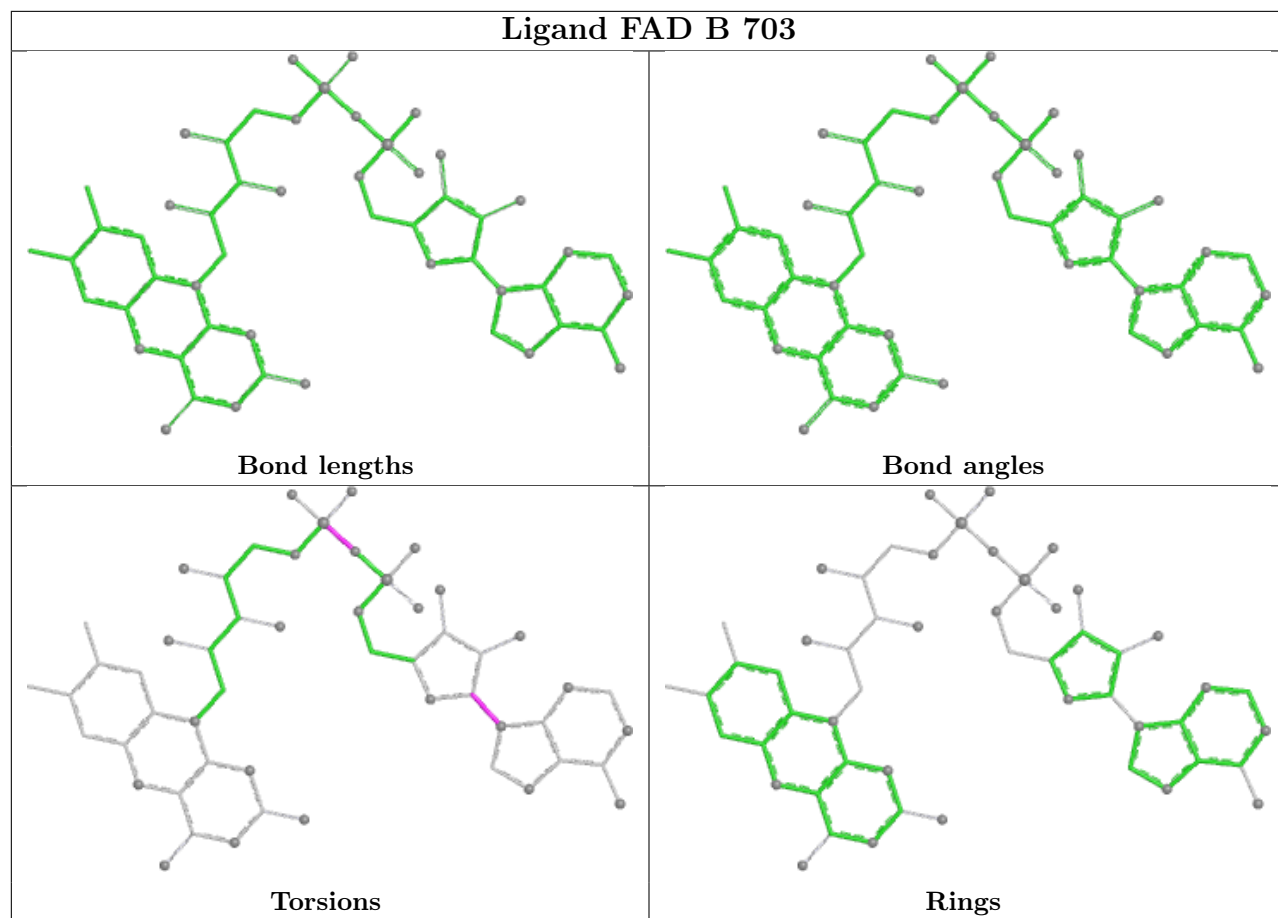
Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	704	TDK	1	0

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	548/677 (80%)	-0.03	40 (7%) 21 18	23, 38, 86, 138	1 (0%)
1	B	551/677 (81%)	0.64	109 (19%) 3 2	25, 48, 101, 120	0
All	All	1099/1354 (81%)	0.30	149 (13%) 7 5	23, 41, 97, 138	1 (0%)

All (149) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	590	PHE	8.0
1	B	83	PRO	6.8
1	A	589	LEU	6.8
1	A	83	PRO	6.5
1	A	583	VAL	5.8
1	B	443	GLU	5.7
1	A	582	MET	5.6
1	B	583	VAL	5.5
1	B	270	SER	5.4
1	B	597	HIS	5.4
1	A	596	SER	5.3
1	B	649	VAL	5.3
1	B	448	PHE	5.2
1	A	647	LYS	5.2
1	B	276	LEU	5.1
1	A	269	PRO	5.0
1	B	387	LYS	5.0
1	B	385	ILE	5.0
1	B	298	LEU	5.0
1	A	597	HIS	4.9
1	A	201	PHE	4.8
1	B	440	PRO	4.8
1	A	584	THR	4.7
1	B	439	PHE	4.7

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	442	LYS	4.7
1	B	581	GLY	4.4
1	B	445	SER	4.4
1	A	580	GLN	4.4
1	B	447	TRP	4.3
1	B	441	VAL	4.2
1	B	596	SER	4.2
1	A	587	GLN	4.2
1	B	129	ASP	4.2
1	A	463	MET	4.2
1	B	646	ASP	4.1
1	A	357[A]	CYS	4.1
1	B	323	LEU	4.0
1	A	282	ASP	4.0
1	B	648	LYS	3.9
1	A	581	GLY	3.9
1	B	446	GLU	3.8
1	B	379	ASP	3.8
1	A	268	LEU	3.7
1	A	586	TRP	3.6
1	B	299	ALA	3.6
1	B	462	TYR	3.6
1	A	202	GLN	3.6
1	B	371	ILE	3.5
1	B	284	PHE	3.5
1	A	198	THR	3.5
1	B	458	TYR	3.5
1	B	285	VAL	3.4
1	B	275	GLN	3.4
1	A	284	PHE	3.4
1	A	599	HIS	3.4
1	B	370	ILE	3.4
1	B	460	TYR	3.4
1	A	588	SER	3.4
1	B	404	ILE	3.3
1	B	303	VAL	3.3
1	B	467	PRO	3.3
1	B	295	LEU	3.2
1	B	598	THR	3.2
1	B	330	PRO	3.2
1	A	585	GLN	3.2
1	B	434	MET	3.2

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	B	402	GLY	3.2
1	A	199	ASP	3.2
1	B	485	ASN	3.2
1	B	463	MET	3.2
1	B	357	CYS	3.1
1	A	623	GLU	3.1
1	A	579	GLU	3.1
1	B	331	VAL	3.1
1	B	296	ILE	3.0
1	B	415	LYS	3.0
1	B	438	ILE	3.0
1	B	454	TRP	3.0
1	B	401	GLY	3.0
1	A	200	ALA	2.9
1	B	582	MET	2.9
1	B	444	ARG	2.9
1	B	421	ILE	2.9
1	A	411	LYS	2.8
1	B	327	ALA	2.8
1	B	300	LYS	2.8
1	B	369	LEU	2.8
1	B	419	THR	2.8
1	B	418	GLN	2.8
1	B	451	ILE	2.7
1	B	406	PHE	2.7
1	B	329	ILE	2.7
1	B	301	LYS	2.6
1	B	283	GLU	2.6
1	B	431	LEU	2.6
1	B	468	GLY	2.6
1	B	580	GLN	2.6
1	B	127	ASN	2.6
1	B	294	ASP	2.6
1	B	453	LYS	2.6
1	B	449	ALA	2.6
1	A	283	GLU	2.5
1	B	277	THR	2.5
1	A	354	MET	2.5
1	B	297	ASN	2.5
1	A	203	GLU	2.5
1	B	470	LYS	2.5
1	B	368	ASP	2.5

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	196	ILE	2.4
1	B	389	ALA	2.4
1	B	302	PRO	2.4
1	B	320	LEU	2.4
1	B	450	GLN	2.4
1	B	291	LYS	2.3
1	B	436	SER	2.3
1	B	319	LEU	2.3
1	A	195	ALA	2.3
1	B	281	GLN	2.3
1	B	411	LYS	2.3
1	B	364	VAL	2.3
1	B	459	PRO	2.3
1	A	285	VAL	2.3
1	A	446	GLU	2.2
1	B	397	ALA	2.2
1	B	326	ARG	2.2
1	B	363	ALA	2.2
1	B	396	ALA	2.2
1	B	362	LEU	2.2
1	B	435	MET	2.2
1	B	432	GLY	2.2
1	B	437	LYS	2.2
1	B	464	GLU	2.2
1	A	194	SER	2.2
1	B	400	ARG	2.1
1	B	289	ILE	2.1
1	B	417	VAL	2.1
1	A	355	HIS	2.1
1	B	600	GLN	2.1
1	B	399	GLY	2.1
1	B	324	SER	2.1
1	B	365	GLN	2.1
1	B	599	HIS	2.1
1	B	359	THR	2.1
1	B	268	LEU	2.1
1	B	384	ASN	2.1
1	A	197	GLY	2.0
1	B	287	GLN	2.0
1	B	279	ARG	2.0
1	B	394	ARG	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 ⓘ

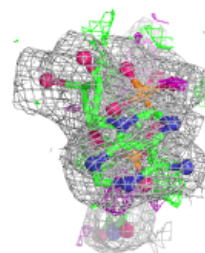
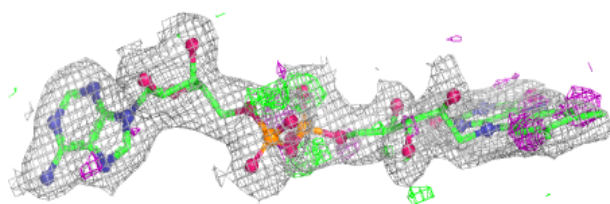
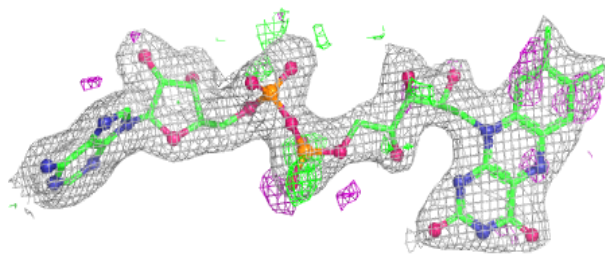
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
4	FAD	A	703	53/53	0.95	0.10	27,33,38,61	0
4	FAD	B	703	53/53	0.96	0.09	27,33,38,61	0
2	K	B	702	1/1	0.98	0.07	56,56,56,56	0
5	TDK	A	704	34/34	0.98	0.07	24,31,52,63	0
5	TDK	B	704	34/34	0.98	0.07	24,30,48,58	0
3	MG	A	702	1/1	0.99	0.02	30,30,30,30	0
3	MG	B	701	1/1	0.99	0.04	30,30,30,30	0
2	K	A	701	1/1	0.99	0.03	37,37,37,37	0

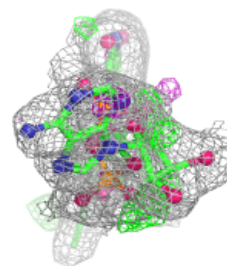
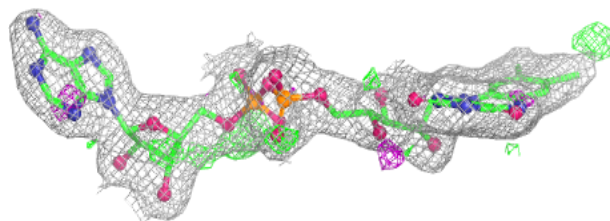
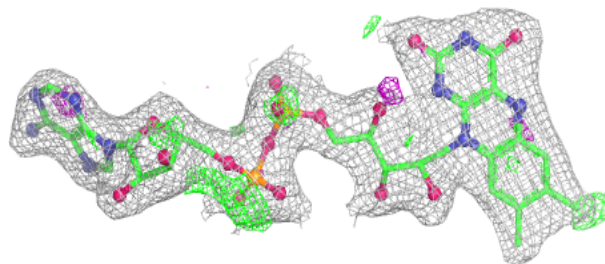
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around FAD A 703:

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

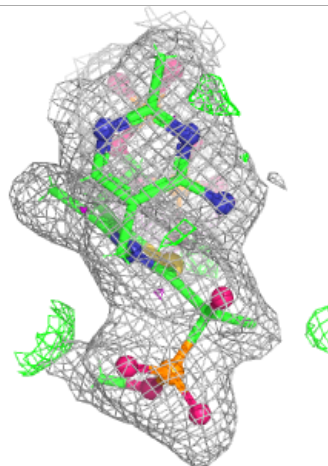
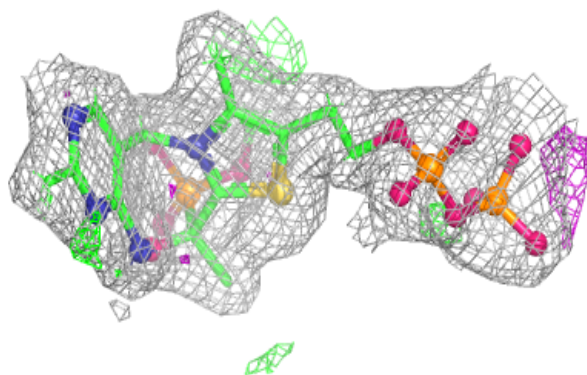
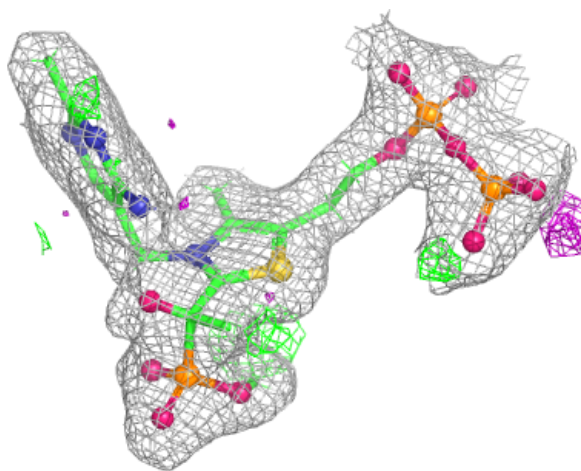
**Electron density around FAD B 703:**

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



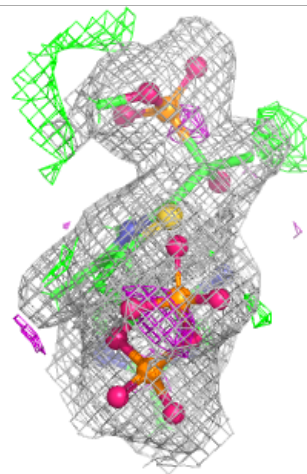
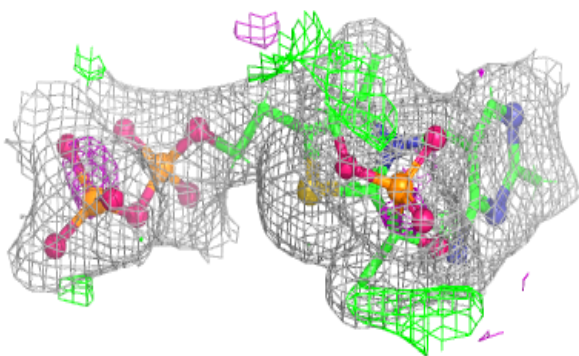
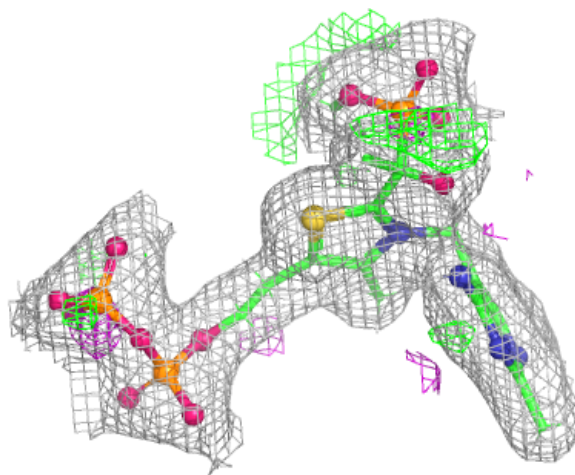
Electron density around TDK A 704:

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



Electron density around TDK B 704:

$2mF_o-DF_c$ (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.