



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 18, 2026 – 01:47 AM UTC

PDB ID : 5T5M / pdb_00005t5m
Title : TUNGSTEN-CONTAINING FORMYLMETHANOFURAN DEHYDROGENASE FROM METHANOTHERMOBACTER WOLFEII, TRIGONAL FORM AT 2.5 Å.
Authors : Wagner, T.; Ermler, U.; Shima, S.
Deposited on : 2016-08-31
Resolution : 2.50 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

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

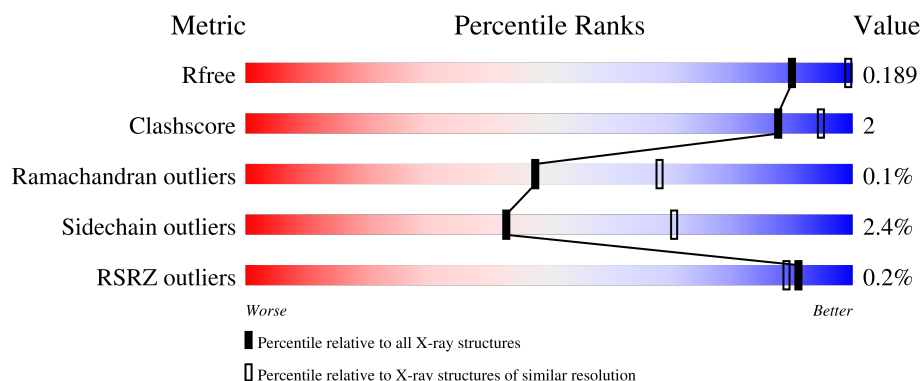
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

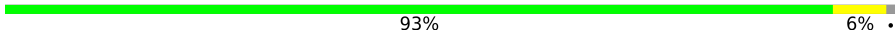
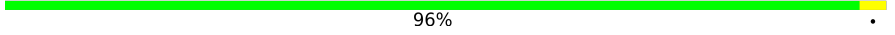
The reported resolution of this entry is 2.50 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments 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	569	 92% 7% .
2	B	432	 93% 6% .
3	C	270	 96% .
4	D	130	 89% 8% .

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Mol	Chain	Length	Quality of chain
5	F	349	 89%8% •
6	G	82	 89%7% ••

2 Entry composition

There are 15 unique types of molecules in this entry. The entry contains 14415 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 Tungsten formylmethanofuran dehydrogenase subunit fwdA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	569	Total	C	N	O	S	0	0	0
			4419	2812	735	849	23			

- Molecule 2 is a protein called Tungsten formylmethanofuran dehydrogenase subunit fwdB.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	429	Total	C	N	O	S	0	2	0
			3375	2122	593	629	31			

- Molecule 3 is a protein called Tungsten-containing formylmethanofuran dehydrogenase 2 subunit C.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	269	Total	C	N	O	S	0	0	0
			1994	1254	336	391	13			

- Molecule 4 is a protein called Tungsten formylmethanofuran dehydrogenase subunit fwdD.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	126	Total	C	N	O	S	0	0	0
			977	625	158	185	9			

- Molecule 5 is a protein called Tungsten formylmethanofuran dehydrogenase subunit fwdF.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	F	342	Total	C	N	O	S	0	0	0
			2610	1611	435	523	41			

- Molecule 6 is a protein called Tungsten formylmethanofuran dehydrogenase subunit fwdG.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	G	80	Total	C	N	O	S	0	0	0
			572	354	96	113	9			

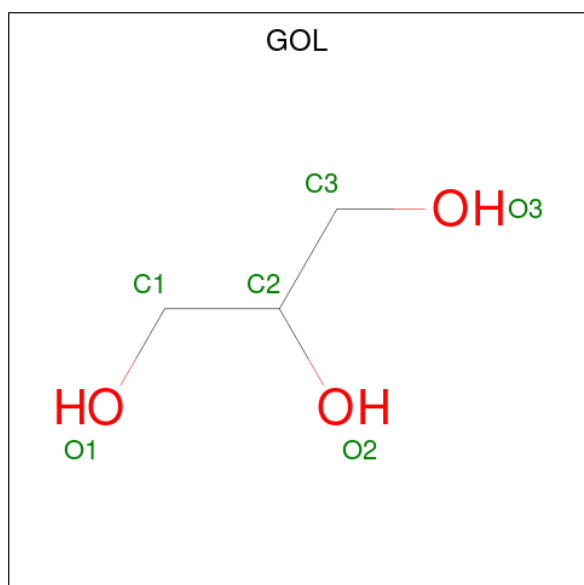
- Molecule 7 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	2	Total	Mg	0	0
			2	2		
7	C	1	Total	Mg	0	0
			1	1		

- Molecule 8 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	2	Total	Zn	0	0
			2	2		

- Molecule 9 is GLYCEROL (CCD ID: GOL) (formula: C₃H₈O₃).

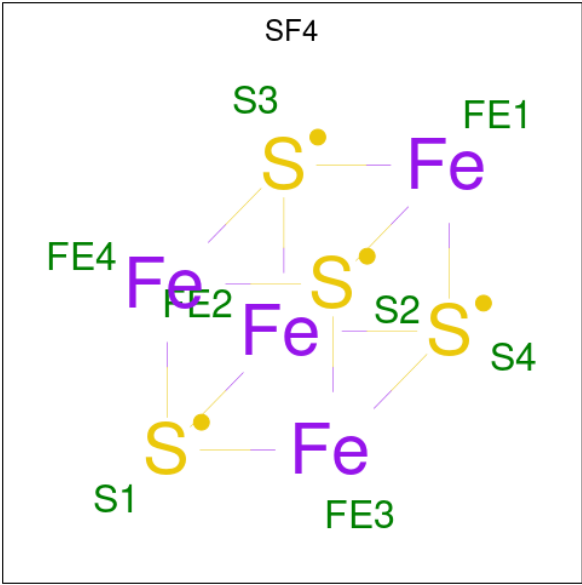


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
9	A	1	Total	C	O	0	0
			6	3	3		
9	A	1	Total	C	O	0	0
			6	3	3		
9	D	1	Total	C	O	0	0
			6	3	3		

- Molecule 10 is POTASSIUM ION (CCD ID: K) (formula: K).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
10	B	1	Total K 1 1	0	0

- Molecule 11 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe₄S₄).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
11	B	1	Total Fe S 8 4 4	0	0
11	F	1	Total Fe S 8 4 4	0	0
11	F	1	Total Fe S 8 4 4	0	0
11	F	1	Total Fe S 8 4 4	0	0
11	F	1	Total Fe S 8 4 4	0	0
11	F	1	Total Fe S 8 4 4	0	0
11	F	1	Total Fe S 8 4 4	0	0
11	F	1	Total Fe S 8 4 4	0	0
11	F	1	Total Fe S 8 4 4	0	0
11	G	1	Total Fe S 8 4 4	0	0

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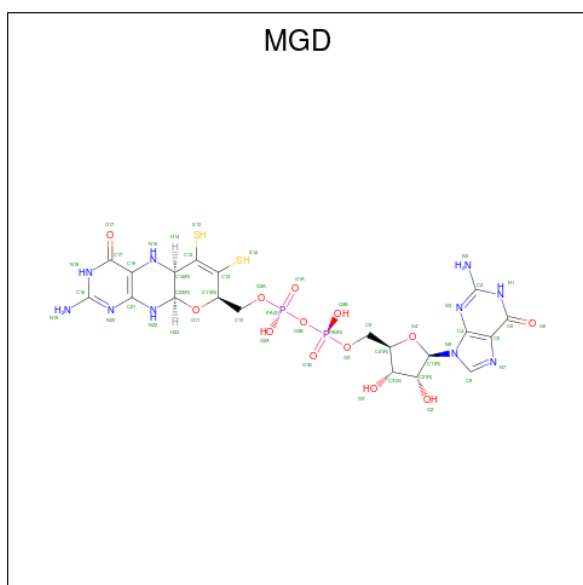
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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
11	G	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 12 is TUNGSTEN ION (CCD ID: W) (formula: W).

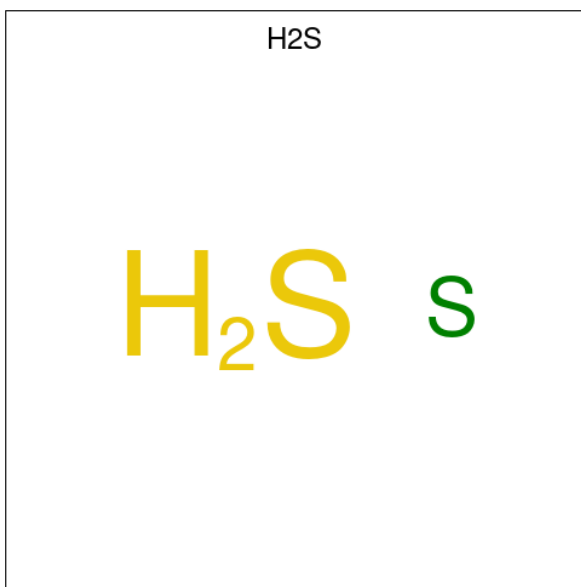
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
12	B	1	Total	W	0	0
			1	1		

- Molecule 13 is 2-AMINO-5,6-DIMERCAPTO-7-METHYL-3,7,8A,9-TETRAHYDRO-8-OXA-1,3,9,10-TETRAAZA-ANTHRACEN-4-ONE GUANOSINE DINUCLEOTIDE (CCD ID: MGD) (formula: C₂₀H₂₆N₁₀O₁₃P₂S₂).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
13	B	1	Total 47	C 20	N 10	O 13	P 2	S 2	0	0
13	B	1	Total 47	C 20	N 10	O 13	P 2	S 2	0	0

- Molecule 14 is HYDROSULFURIC ACID (CCD ID: H2S) (formula: H₂S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
14	B	1	Total S 1 1	0	0

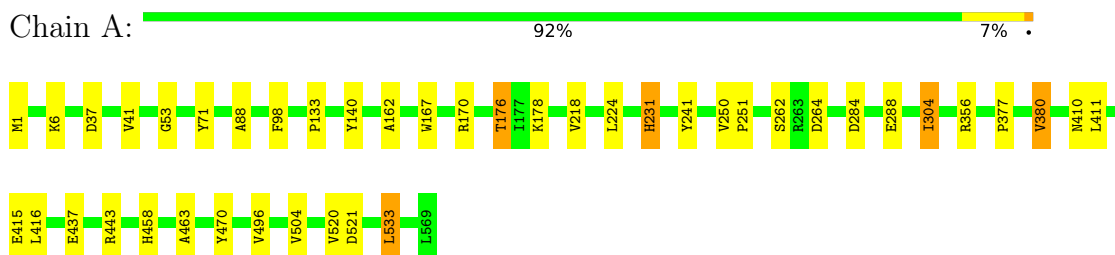
- Molecule 15 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
15	A	97	Total O 97 97	0	0
15	B	69	Total O 69 69	0	0
15	C	38	Total O 38 38	0	0
15	D	10	Total O 10 10	0	0
15	F	39	Total O 39 39	0	0
15	G	7	Total O 7 7	0	0

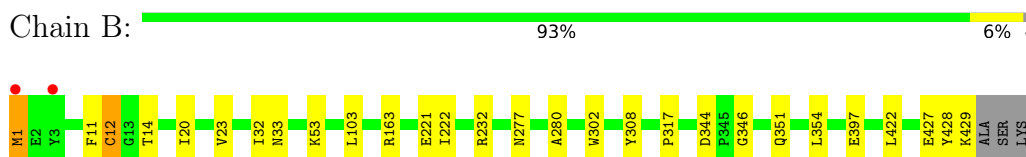
3 Residue-property plots [i](#)

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.

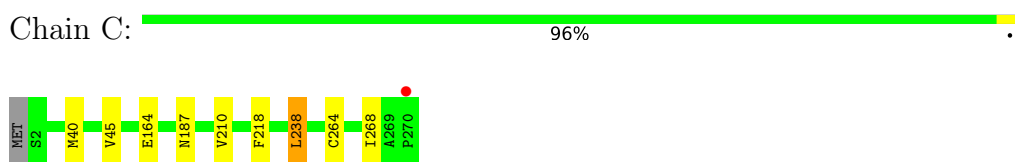
- Molecule 1: Tungsten formylmethanofuran dehydrogenase subunit fwdA



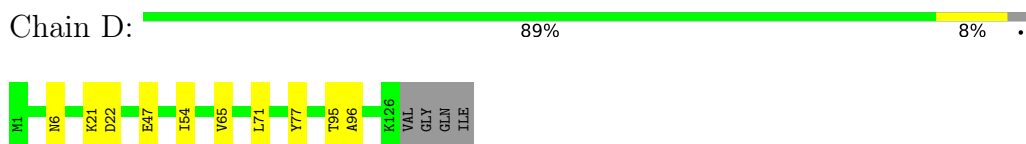
- Molecule 2: Tungsten formylmethanofuran dehydrogenase subunit fwdB



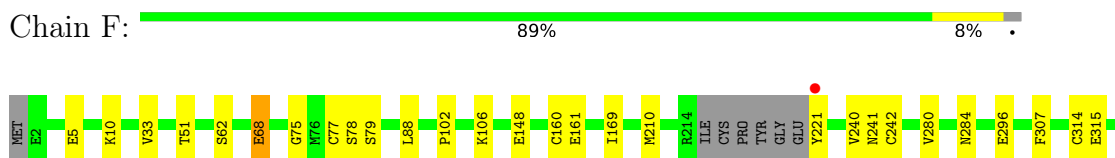
- Molecule 3: Tungsten-containing formylmethanofuran dehydrogenase 2 subunit C



- Molecule 4: Tungsten formylmethanofuran dehydrogenase subunit fwdD

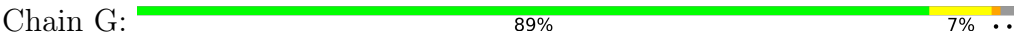


- Molecule 5: Tungsten formylmethanofuran dehydrogenase subunit fwdF





- Molecule 6: Tungsten formylmethanofuran dehydrogenase subunit fwdG



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	105.54Å 105.54Å 340.55Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.22 – 2.50 48.22 – 2.50	Depositor EDS
% Data completeness (in resolution range)	99.9 (48.22-2.50) 99.9 (48.22-2.50)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	0.04	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.18 (at 2.51Å)	Xtriage
Refinement program	PHENIX (1.10.1_2155: ???)	Depositor
R, R_{free}	0.158 , 0.182 0.167 , 0.189	Depositor DCC
R_{free} test set	3639 reflections (4.71%)	wwPDB-VP
Wilson B-factor (Å ²)	58.0	Xtriage
Anisotropy	0.370	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 44.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.026 for -h,-k,l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	14415	wwPDB-VP
Average B, all atoms (Å ²)	68.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.59% 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: GOL, ZN, MG, H2S, SF4, W, MGD, K, KCX

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	0.25	0/4523	0.45	0/6161
2	B	0.28	0/3451	0.45	0/4669
3	C	0.26	0/2027	0.44	0/2729
4	D	0.24	0/996	0.44	0/1352
5	F	0.26	0/2646	0.44	0/3586
6	G	0.22	0/579	0.42	0/787
All	All	0.26	0/14222	0.45	0/19284

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	4419	0	4273	22	0
2	B	3375	0	3325	13	0
3	C	1994	0	1962	3	0
4	D	977	0	1002	5	0
5	F	2610	0	2567	14	0
6	G	572	0	567	2	0
7	A	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
7	C	1	0	0	0	0
8	A	2	0	0	0	0
9	A	12	0	16	0	0
9	D	6	0	8	0	0
10	B	1	0	0	0	0
11	B	8	0	0	0	0
11	F	64	0	0	0	0
11	G	16	0	0	0	0
12	B	1	0	0	0	0
13	B	94	0	44	0	0
14	B	1	0	0	0	0
15	A	97	0	0	2	0
15	B	69	0	0	0	0
15	C	38	0	0	0	0
15	D	10	0	0	0	0
15	F	39	0	0	0	0
15	G	7	0	0	0	0
All	All	14415	0	13764	57	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 (57) 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:284:ASP:O	15:A:701:HOH:O	2.11	0.68
1:A:264:ASP:O	15:A:702:HOH:O	2.12	0.66
1:A:224:LEU:HD22	1:A:520:VAL:HG11	1.81	0.61
1:A:411:LEU:HG	1:A:416:LEU:HG	1.86	0.58
3:C:210:VAL:HG11	3:C:238:LEU:HD13	1.88	0.55
2:B:20:ILE:HB	2:B:32:ILE:HB	1.87	0.55
5:F:10:LYS:O	5:F:62:SER:OG	2.16	0.54
1:A:88:ALA:HB1	2:B:317:PRO:HD3	1.91	0.53
1:A:356:ARG:NH2	1:A:415:GLU:OE2	2.42	0.53
2:B:427:GLU:O	2:B:429:LYS:N	2.42	0.52
6:G:42:VAL:HG22	6:G:44:ILE:HG23	1.92	0.51
2:B:427:GLU:C	2:B:429:LYS:H	2.18	0.51
2:B:344:ASP:OD2	4:D:21:LYS:NZ	2.42	0.49
5:F:68:GLU:H	5:F:68:GLU:CD	2.21	0.49
6:G:18:CYS:HB2	6:G:67:CYS:HB2	1.95	0.48
1:A:167:TRP:CD1	1:A:533:LEU:HD11	2.50	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:103:LEU:HD13	2:B:422:LEU:HA	1.97	0.46
1:A:53:GLY:HA2	1:A:443:ARG:HG3	1.98	0.46
4:D:22:ASP:OD1	4:D:22:ASP:N	2.42	0.46
2:B:1:MET:HA	2:B:23:VAL:O	2.16	0.45
1:A:496:VAL:HB	1:A:504:VAL:HB	1.98	0.45
5:F:106:LYS:HD3	5:F:241:ASN:OD1	2.17	0.45
2:B:346:GLY:HA2	2:B:354:LEU:HD11	1.99	0.45
4:D:71:LEU:HD21	4:D:77:TYR:HB2	1.99	0.44
5:F:77:CYS:SG	5:F:78:SER:N	2.91	0.44
3:C:40:MET:SD	3:C:45:VAL:HG22	2.58	0.44
1:A:458:HIS:CE1	1:A:463:ALA:HB2	2.52	0.44
5:F:160:CYS:SG	5:F:161:GLU:N	2.91	0.44
5:F:5:GLU:CB	5:F:68:GLU:HG2	2.48	0.44
2:B:277:ASN:HA	2:B:280:ALA:O	2.18	0.43
1:A:140:TYR:CE1	1:A:176:THR:HG23	2.53	0.43
1:A:140:TYR:CD1	1:A:176:THR:HG23	2.54	0.43
4:D:6:ASN:O	4:D:77:TYR:HA	2.17	0.43
2:B:32:ILE:O	2:B:33:ASN:HB2	2.19	0.42
5:F:75:GLY:HA3	5:F:88:LEU:HD22	2.01	0.42
5:F:314:CYS:SG	5:F:315:GLU:N	2.92	0.42
1:A:162:ALA:HA	1:A:218:VAL:HG13	2.02	0.42
2:B:222:ILE:O	2:B:232:ARG:NH1	2.37	0.42
4:D:95:THR:O	4:D:96:ALA:HB3	2.20	0.42
5:F:148:GLU:HG2	5:F:210:MET:HE3	2.01	0.42
5:F:242:CYS:O	5:F:307:PHE:HA	2.20	0.42
1:A:6:LYS:HG3	1:A:41:VAL:HG13	2.02	0.41
1:A:231:HIS:CD2	1:A:231:HIS:C	2.98	0.41
1:A:377:PRO:HG3	1:A:437:GLU:HG2	2.02	0.41
1:A:98:PHE:HA	1:A:133:PRO:HD3	2.02	0.41
5:F:160:CYS:SG	5:F:169:ILE:HG21	2.61	0.41
1:A:170:ARG:NH2	1:A:521:ASP:OD1	2.37	0.41
1:A:304:ILE:O	1:A:380:VAL:HA	2.20	0.41
5:F:79:SER:OG	5:F:102:PRO:O	2.38	0.41
2:B:14:THR:HG22	2:B:163[A]:ARG:NH1	2.36	0.41
3:C:218:PHE:HB2	3:C:268:ILE:HD12	2.03	0.41
5:F:5:GLU:HB3	5:F:68:GLU:HG2	2.02	0.41
1:A:241:TYR:CD1	1:A:288:GLU:HG3	2.55	0.40
1:A:443:ARG:NH2	1:A:470:TYR:OH	2.50	0.40
5:F:33:VAL:HB	5:F:51:THR:HG23	2.02	0.40
1:A:250:VAL:HB	1:A:251:PRO:HD3	2.03	0.40
2:B:11:PHE:HD2	2:B:12:CYS:HB3	1.86	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	566/569 (100%)	543 (96%)	23 (4%)	0	100	100
2	B	429/432 (99%)	412 (96%)	16 (4%)	1 (0%)	43	63
3	C	267/270 (99%)	258 (97%)	9 (3%)	0	100	100
4	D	124/130 (95%)	118 (95%)	6 (5%)	0	100	100
5	F	338/349 (97%)	333 (98%)	5 (2%)	0	100	100
6	G	78/82 (95%)	78 (100%)	0	0	100	100
All	All	1802/1832 (98%)	1742 (97%)	59 (3%)	1 (0%)	48	68

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	428	TYR

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	470/470 (100%)	460 (98%)	10 (2%)	47	74
2	B	361/361 (100%)	353 (98%)	8 (2%)	45	73
3	C	203/204 (100%)	199 (98%)	4 (2%)	48	75

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
4	D	108/111 (97%)	105 (97%)	3 (3%)	38	66
5	F	306/312 (98%)	298 (97%)	8 (3%)	40	68
6	G	65/67 (97%)	61 (94%)	4 (6%)	16	34
All	All	1513/1525 (99%)	1476 (98%)	37 (2%)	43	70

All (37) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	37	ASP
1	A	71	TYR
1	A	176	THR
1	A	231	HIS
1	A	262	SER
1	A	304	ILE
1	A	380	VAL
1	A	410	ASN
1	A	533	LEU
2	B	1	MET
2	B	12	CYS
2	B	53	LYS
2	B	221	GLU
2	B	302	TRP
2	B	308	TYR
2	B	351	GLN
2	B	397	GLU
3	C	164	GLU
3	C	187	ASN
3	C	238	LEU
3	C	264	CYS
4	D	47	GLU
4	D	54	ILE
4	D	65	VAL
5	F	68	GLU
5	F	221	TYR
5	F	240	VAL
5	F	280	VAL
5	F	284	ASN
5	F	296	GLU
5	F	323	ILE
5	F	349	LYS

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Mol	Chain	Res	Type
6	G	42	VAL
6	G	43	GLU
6	G	46	MET
6	G	69	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	15	ASN
1	A	523	GLN
5	F	84	GLN
5	F	174	GLN
5	F	196	HIS
5	F	211	GLN
6	G	57	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

1 non-standard protein/DNA/RNA residue is 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	$\# Z > 2$
1	KCX	A	178	1,8	10,11,12	0.64	0	6,12,14	1.43	1 (16%)

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
1	KCX	A	178	1,8	-	0/9/10/12	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	178	KCX	OQ1-CX-NZ	-2.43	121.24	124.92

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 24 ligands modelled in this entry, 7 are monoatomic and 1 is modelled with single atom - leaving 16 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	$\# Z > 2$
13	MGD	B	505	12	47,52,52	1.53	9 (19%)	58,81,81	2.13	15 (25%)
11	SF4	B	502	2	0,12,12	-	-	-		
11	SF4	F	505	5	0,12,12	-	-	-		
9	GOL	A	606	-	5,5,5	0.34	0	5,5,5	0.38	0
9	GOL	D	201	-	5,5,5	0.39	0	5,5,5	0.57	0
9	GOL	A	605	-	5,5,5	0.35	0	5,5,5	0.25	0
11	SF4	F	503	5	0,12,12	-	-	-		
11	SF4	F	506	5	0,12,12	-	-	-		
11	SF4	F	508	5	0,12,12	-	-	-		

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
11	SF4	F	502	5	0,12,12	-	-	-		
13	MGD	B	504	12	47,52,52	1.51	7 (14%)	58,81,81	2.00	13 (22%)
11	SF4	G	200	6	0,12,12	-	-	-		
11	SF4	F	501	5	0,12,12	-	-	-		
11	SF4	F	504	5	0,12,12	-	-	-		
11	SF4	F	507	5	0,12,12	-	-	-		
11	SF4	G	201	6	0,12,12	-	-	-		

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
13	MGD	B	505	12	-	1/22/66/66	0/6/6/6
11	SF4	B	502	2	-	-	0/6/5/5
11	SF4	F	505	5	-	-	0/6/5/5
9	GOL	A	606	-	-	2/4/4/4	-
13	MGD	B	504	12	-	9/22/66/66	0/6/6/6
9	GOL	D	201	-	-	2/4/4/4	-
9	GOL	A	605	-	-	0/4/4/4	-
11	SF4	F	503	5	-	-	0/6/5/5
11	SF4	F	506	5	-	-	0/6/5/5
11	SF4	F	502	5	-	-	0/6/5/5
11	SF4	F	508	5	-	-	0/6/5/5
11	SF4	G	200	6	-	-	0/6/5/5
11	SF4	F	501	5	-	-	0/6/5/5
11	SF4	F	504	5	-	-	0/6/5/5
11	SF4	F	507	5	-	-	0/6/5/5
11	SF4	G	201	6	-	-	0/6/5/5

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
13	B	504	MGD	C16-C21	5.11	1.47	1.38
13	B	505	MGD	C16-C21	5.02	1.47	1.38
13	B	505	MGD	C21-N22	-3.21	1.32	1.35
13	B	504	MGD	C5-C4	3.10	1.47	1.38
13	B	504	MGD	PA-O3B	3.09	1.62	1.59
13	B	505	MGD	PA-O3B	3.01	1.62	1.59
13	B	504	MGD	C17-N18	-2.99	1.33	1.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
13	B	504	MGD	C6-N1	-2.94	1.33	1.38
13	B	504	MGD	PB-O3B	2.87	1.62	1.59
13	B	505	MGD	PB-O3B	2.85	1.62	1.59
13	B	505	MGD	C5-C4	2.66	1.46	1.38
13	B	505	MGD	C17-N18	-2.62	1.33	1.38
13	B	505	MGD	C4-N9	-2.46	1.31	1.38
13	B	505	MGD	C6-N1	-2.19	1.34	1.38
13	B	504	MGD	C5-N7	-2.17	1.34	1.39
13	B	505	MGD	C5-N7	-2.13	1.34	1.39

All (28) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
13	B	505	MGD	C23-C14-N15	7.62	115.35	107.87
13	B	504	MGD	C5-C4-N3	-6.22	118.49	128.39
13	B	504	MGD	C23-C14-N15	5.95	113.71	107.87
13	B	505	MGD	C5-C4-N3	-4.57	121.12	128.39
13	B	505	MGD	C2-N3-C4	4.45	119.97	112.30
13	B	504	MGD	C2-N3-C4	4.43	119.93	112.30
13	B	504	MGD	C19-N20-C21	4.32	120.98	113.36
13	B	504	MGD	N9-C4-N3	4.21	134.37	125.95
13	B	505	MGD	C6-C5-N7	4.07	137.69	130.29
13	B	505	MGD	C19-N20-C21	4.03	120.47	113.36
13	B	504	MGD	O11-C23-N22	3.68	111.94	108.61
13	B	504	MGD	O11-C23-C14	-3.58	106.58	108.96
13	B	505	MGD	O11-C23-C14	3.38	111.22	108.96
13	B	505	MGD	O17-C17-C16	-3.16	119.63	127.26
13	B	505	MGD	N9-C4-N3	3.11	132.18	125.95
13	B	505	MGD	C17-C16-N15	3.01	124.48	116.27
13	B	504	MGD	C6-C5-N7	2.98	135.72	130.29
13	B	504	MGD	C4-C5-N7	-2.97	105.96	110.67
13	B	505	MGD	C4'-O4'-C1'	-2.89	103.09	109.47
13	B	505	MGD	O11-C23-N22	-2.85	106.02	108.61
13	B	505	MGD	C4-C5-N7	-2.75	106.31	110.67
13	B	504	MGD	C17-C16-N15	2.65	123.49	116.27
13	B	505	MGD	C16-C17-N18	2.41	118.76	112.13
13	B	504	MGD	O17-C17-C16	-2.40	121.47	127.26
13	B	504	MGD	C16-C17-N18	2.35	118.57	112.13
13	B	505	MGD	O6-C6-C5	-2.27	120.53	126.53
13	B	504	MGD	C8-N7-C5	2.25	108.27	104.26
13	B	505	MGD	C1'-N9-C4	-2.05	120.44	126.49

There are no chirality outliers.

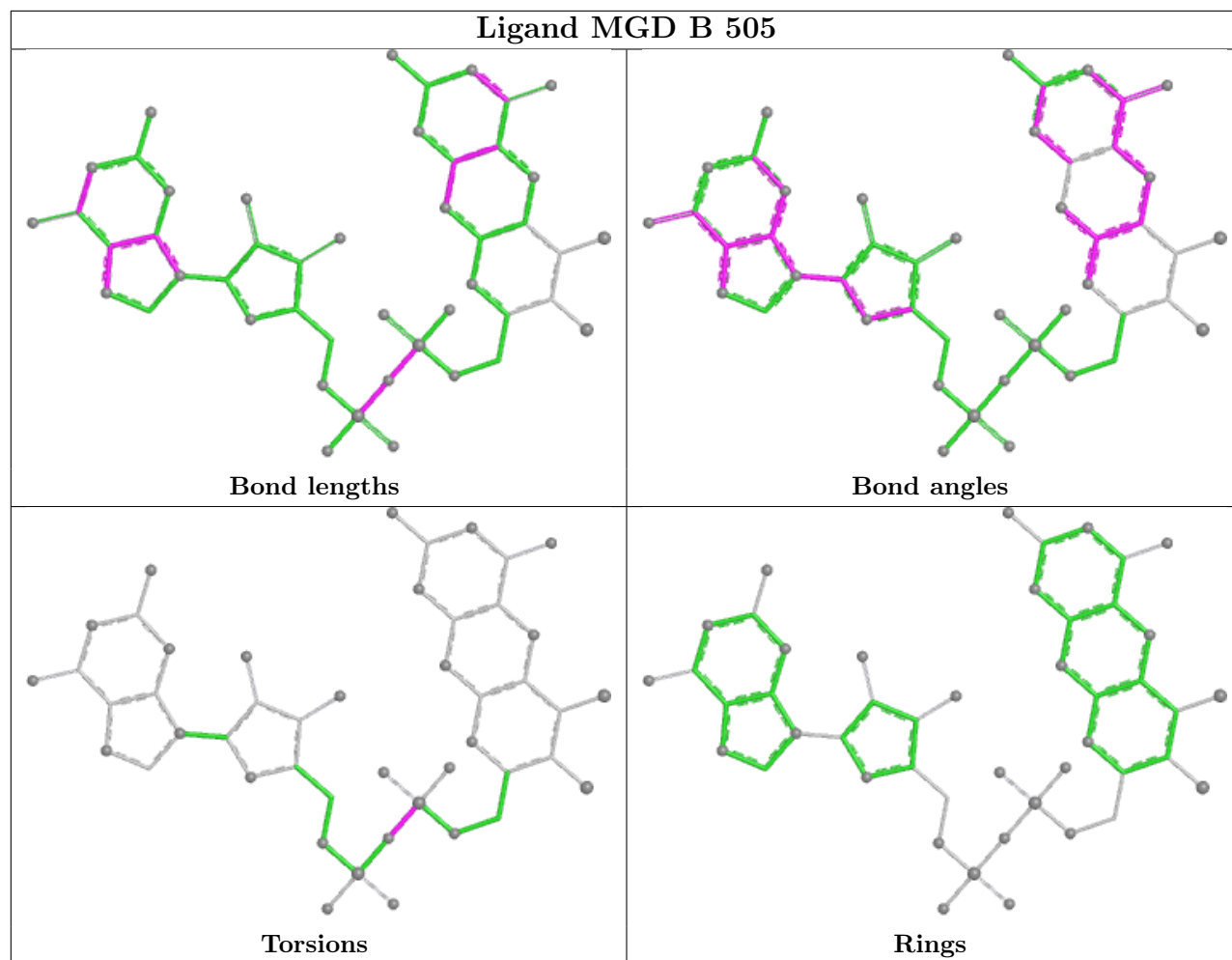
All (14) torsion outliers are listed below:

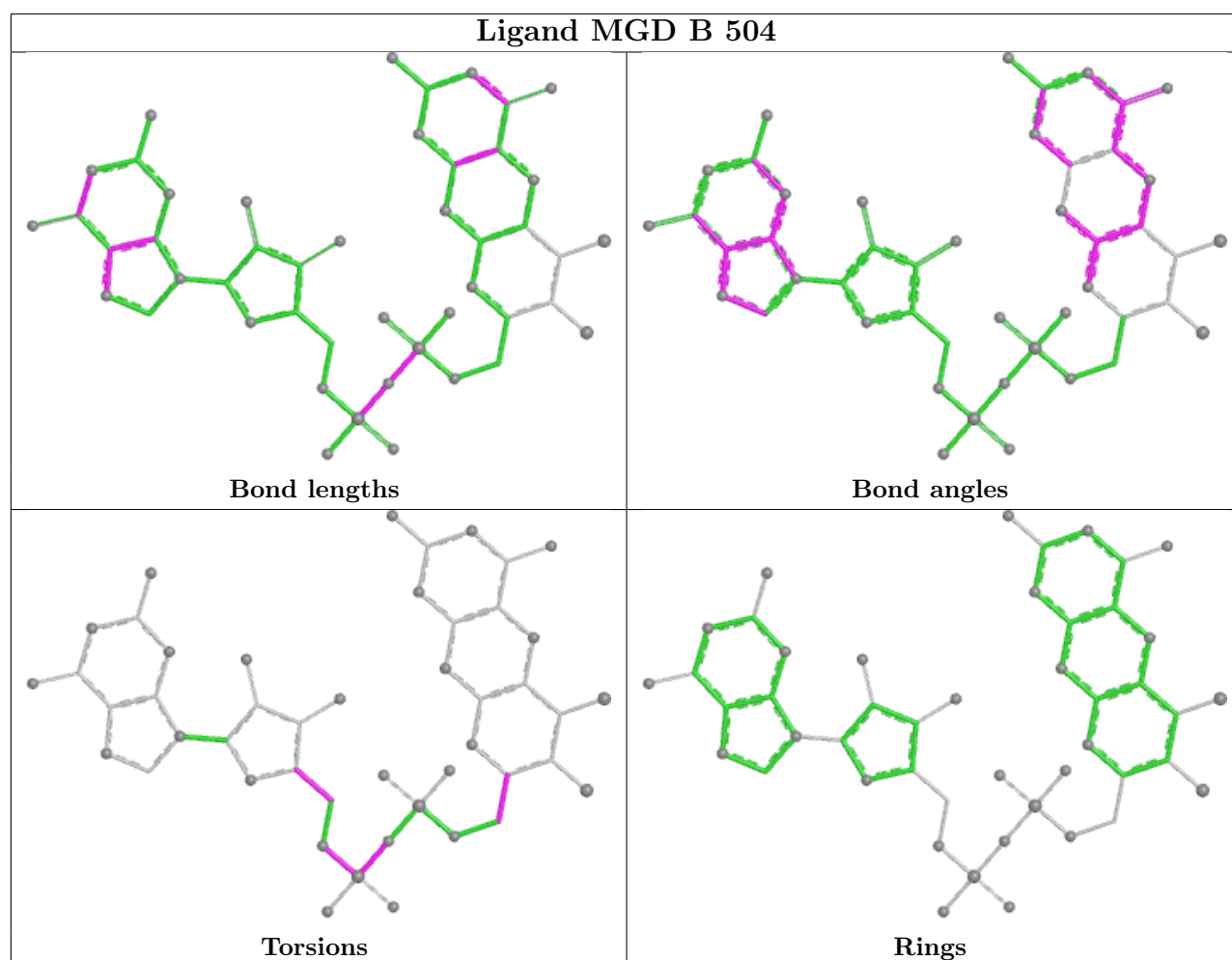
Mol	Chain	Res	Type	Atoms
9	D	201	GOL	C1-C2-C3-O3
13	B	504	MGD	C5'-O5'-PB-O1B
13	B	504	MGD	C5'-O5'-PB-O2B
13	B	504	MGD	C5'-O5'-PB-O3B
13	B	504	MGD	O3A-C10-C11-C12
9	A	606	GOL	O1-C1-C2-C3
9	A	606	GOL	O1-C1-C2-O2
9	D	201	GOL	O2-C2-C3-O3
13	B	504	MGD	O3A-C10-C11-O11
13	B	504	MGD	PA-O3B-PB-O5'
13	B	504	MGD	O4'-C4'-C5'-O5'
13	B	504	MGD	C3'-C4'-C5'-O5'
13	B	504	MGD	PA-O3B-PB-O2B
13	B	505	MGD	PB-O3B-PA-O2A

There are no ring outliers.

No monomer is involved in short contacts.

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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 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	568/569 (99%)	-0.49	0 100 100	41, 64, 94, 128	0
2	B	429/432 (99%)	-0.37	2 (0%) 87 85	33, 62, 101, 143	2 (0%)
3	C	269/270 (99%)	-0.55	1 (0%) 88 86	43, 60, 90, 122	0
4	D	126/130 (96%)	-0.31	0 100 100	52, 71, 96, 106	0
5	F	342/349 (97%)	-0.23	1 (0%) 90 87	51, 68, 103, 131	0
6	G	80/82 (97%)	-0.13	0 100 100	59, 72, 97, 111	0
All	All	1814/1832 (99%)	-0.39	4 (0%) 91 89	33, 65, 98, 143	2 (0%)

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	1	MET	2.7
5	F	221	TYR	2.4
2	B	3	TYR	2.4
3	C	270	PRO	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 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
1	KCX	A	178	12/13	0.98	0.05	48,50,56,57	0

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

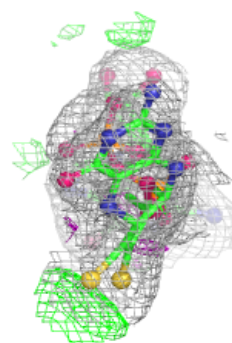
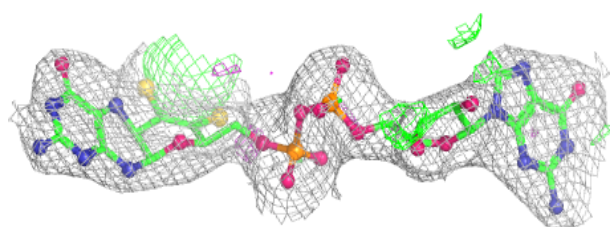
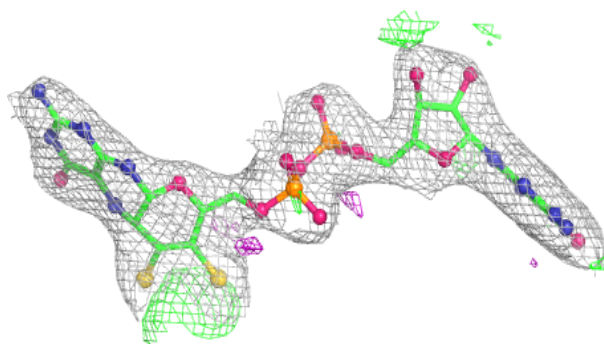
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
10	K	B	501	1/1	0.56	0.19	133,133,133,133	0
9	GOL	D	201	6/6	0.64	0.17	53,54,57,59	0
9	GOL	A	606	6/6	0.84	0.18	57,59,61,66	0
9	GOL	A	605	6/6	0.85	0.12	52,53,56,64	0
7	MG	A	601	1/1	0.95	0.06	65,65,65,65	0
7	MG	C	301	1/1	0.96	0.05	62,62,62,62	0
11	SF4	B	502	8/8	0.97	0.05	50,59,63,67	0
11	SF4	F	505	8/8	0.97	0.04	64,70,80,85	0
13	MGD	B	504	47/47	0.97	0.07	49,62,71,83	0
7	MG	A	604	1/1	0.98	0.03	42,42,42,42	0
11	SF4	F	506	8/8	0.98	0.03	57,62,67,68	0
11	SF4	F	507	8/8	0.98	0.04	43,57,59,60	0
11	SF4	G	200	8/8	0.98	0.03	53,61,68,68	0
11	SF4	G	201	8/8	0.98	0.03	51,66,72,73	0
11	SF4	F	502	8/8	0.98	0.04	46,52,53,53	0
13	MGD	B	505	47/47	0.98	0.06	50,54,58,61	0
11	SF4	F	501	8/8	0.99	0.04	41,51,53,56	0
11	SF4	F	503	8/8	0.99	0.04	46,52,58,60	0
11	SF4	F	504	8/8	0.99	0.03	45,51,58,61	0
11	SF4	F	508	8/8	0.99	0.03	50,54,60,64	0
14	H2S	B	506	1/1	0.99	0.06	60,60,60,60	0
8	ZN	A	603	1/1	1.00	0.02	60,60,60,60	0
8	ZN	A	602	1/1	1.00	0.01	58,58,58,58	0
12	W	B	503	1/1	1.00	0.05	58,58,58,58	0

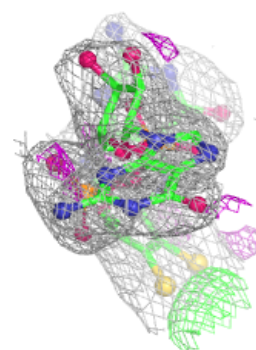
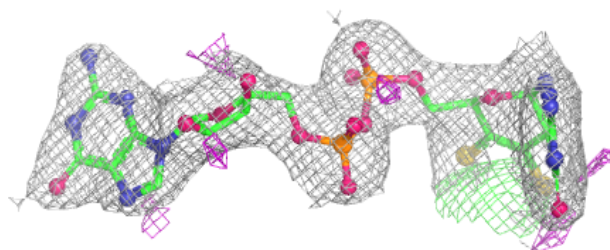
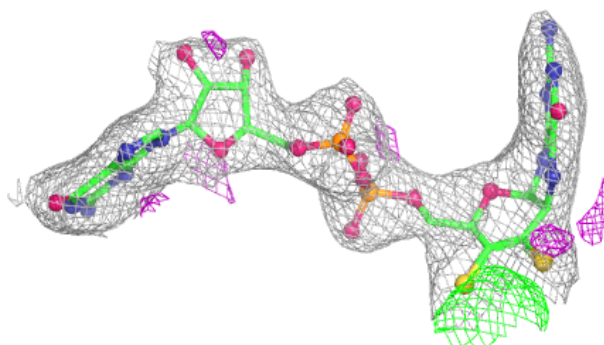
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around MGD B 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 MGD B 505:**

$2mF_o-DF_c$ (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.