



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 14, 2026 – 10:29 PM UTC

PDB ID : 5ESO / pdb_00005eso
Title : Crystal Structure of M. tuberculosis MenD with ThDP, Mg²⁺ and Isochorismate bound
Authors : Johnston, J.M.; Jirgis, E.N.M.; Bashiri, G.; Bulloch, E.M.M.; Baker, E.N.
Deposited on : 2015-11-16
Resolution : 2.05 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

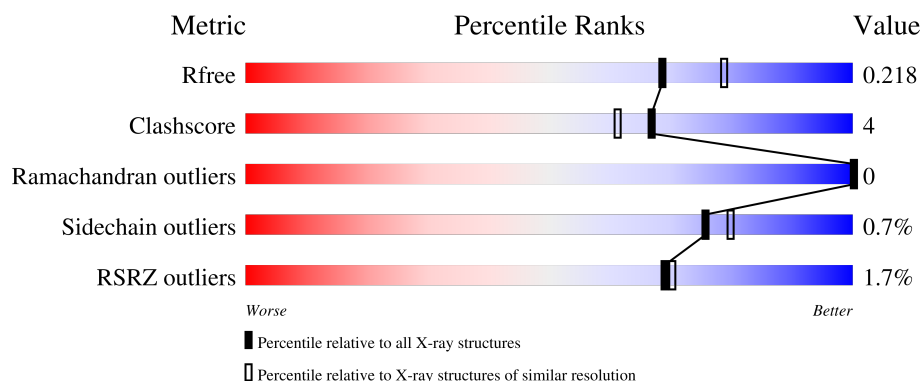
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.05 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	2260 (2.04-2.04)
Clashscore	190562	2333 (2.04-2.04)
Ramachandran outliers	187476	2318 (2.04-2.04)
Sidechain outliers	187428	2318 (2.04-2.04)
RSRZ outliers	180081	2260 (2.04-2.04)

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	574	% 84% 8% 8%
1	B	574	2% 85% 8% • 7%
1	C	574	% 88% 6% • 5%
1	D	574	2% 84% 10% 5%

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 16837 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 2-succinyl-5-enolpyruvyl-6-hydroxy-3-cyclohexene-1-carboxylate synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	529	Total	C	N	O	S	0	8	0
			3959	2464	742	741	12			
1	B	535	Total	C	N	O	S	0	5	0
			3951	2464	735	741	11			
1	C	543	Total	C	N	O	S	0	3	0
			4020	2505	750	754	11			
1	D	543	Total	C	N	O	S	0	3	0
			3988	2485	740	753	10			

There are 80 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	initiating methionine	UNP P9WK11
A	-18	GLY	-	expression tag	UNP P9WK11
A	-17	SER	-	expression tag	UNP P9WK11
A	-16	SER	-	expression tag	UNP P9WK11
A	-15	HIS	-	expression tag	UNP P9WK11
A	-14	HIS	-	expression tag	UNP P9WK11
A	-13	HIS	-	expression tag	UNP P9WK11
A	-12	HIS	-	expression tag	UNP P9WK11
A	-11	HIS	-	expression tag	UNP P9WK11
A	-10	HIS	-	expression tag	UNP P9WK11
A	-9	SER	-	expression tag	UNP P9WK11
A	-8	SER	-	expression tag	UNP P9WK11
A	-7	GLY	-	expression tag	UNP P9WK11
A	-6	LEU	-	expression tag	UNP P9WK11
A	-5	VAL	-	expression tag	UNP P9WK11
A	-4	PRO	-	expression tag	UNP P9WK11
A	-3	ARG	-	expression tag	UNP P9WK11
A	-2	GLY	-	expression tag	UNP P9WK11
A	-1	SER	-	expression tag	UNP P9WK11
A	0	HIS	-	expression tag	UNP P9WK11

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Chain	Residue	Modelled	Actual	Comment	Reference
B	-19	MET	-	initiating methionine	UNP P9WK11
B	-18	GLY	-	expression tag	UNP P9WK11
B	-17	SER	-	expression tag	UNP P9WK11
B	-16	SER	-	expression tag	UNP P9WK11
B	-15	HIS	-	expression tag	UNP P9WK11
B	-14	HIS	-	expression tag	UNP P9WK11
B	-13	HIS	-	expression tag	UNP P9WK11
B	-12	HIS	-	expression tag	UNP P9WK11
B	-11	HIS	-	expression tag	UNP P9WK11
B	-10	HIS	-	expression tag	UNP P9WK11
B	-9	SER	-	expression tag	UNP P9WK11
B	-8	SER	-	expression tag	UNP P9WK11
B	-7	GLY	-	expression tag	UNP P9WK11
B	-6	LEU	-	expression tag	UNP P9WK11
B	-5	VAL	-	expression tag	UNP P9WK11
B	-4	PRO	-	expression tag	UNP P9WK11
B	-3	ARG	-	expression tag	UNP P9WK11
B	-2	GLY	-	expression tag	UNP P9WK11
B	-1	SER	-	expression tag	UNP P9WK11
B	0	HIS	-	expression tag	UNP P9WK11
C	-19	MET	-	initiating methionine	UNP P9WK11
C	-18	GLY	-	expression tag	UNP P9WK11
C	-17	SER	-	expression tag	UNP P9WK11
C	-16	SER	-	expression tag	UNP P9WK11
C	-15	HIS	-	expression tag	UNP P9WK11
C	-14	HIS	-	expression tag	UNP P9WK11
C	-13	HIS	-	expression tag	UNP P9WK11
C	-12	HIS	-	expression tag	UNP P9WK11
C	-11	HIS	-	expression tag	UNP P9WK11
C	-10	HIS	-	expression tag	UNP P9WK11
C	-9	SER	-	expression tag	UNP P9WK11
C	-8	SER	-	expression tag	UNP P9WK11
C	-7	GLY	-	expression tag	UNP P9WK11
C	-6	LEU	-	expression tag	UNP P9WK11
C	-5	VAL	-	expression tag	UNP P9WK11
C	-4	PRO	-	expression tag	UNP P9WK11
C	-3	ARG	-	expression tag	UNP P9WK11
C	-2	GLY	-	expression tag	UNP P9WK11
C	-1	SER	-	expression tag	UNP P9WK11
C	0	HIS	-	expression tag	UNP P9WK11
D	-19	MET	-	initiating methionine	UNP P9WK11
D	-18	GLY	-	expression tag	UNP P9WK11

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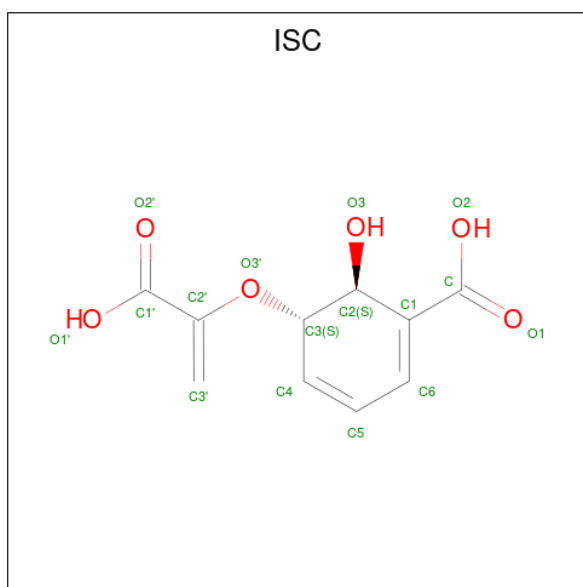
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Chain	Residue	Modelled	Actual	Comment	Reference
D	-17	SER	-	expression tag	UNP P9WK11
D	-16	SER	-	expression tag	UNP P9WK11
D	-15	HIS	-	expression tag	UNP P9WK11
D	-14	HIS	-	expression tag	UNP P9WK11
D	-13	HIS	-	expression tag	UNP P9WK11
D	-12	HIS	-	expression tag	UNP P9WK11
D	-11	HIS	-	expression tag	UNP P9WK11
D	-10	HIS	-	expression tag	UNP P9WK11
D	-9	SER	-	expression tag	UNP P9WK11
D	-8	SER	-	expression tag	UNP P9WK11
D	-7	GLY	-	expression tag	UNP P9WK11
D	-6	LEU	-	expression tag	UNP P9WK11
D	-5	VAL	-	expression tag	UNP P9WK11
D	-4	PRO	-	expression tag	UNP P9WK11
D	-3	ARG	-	expression tag	UNP P9WK11
D	-2	GLY	-	expression tag	UNP P9WK11
D	-1	SER	-	expression tag	UNP P9WK11
D	0	HIS	-	expression tag	UNP P9WK11

- Molecule 2 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

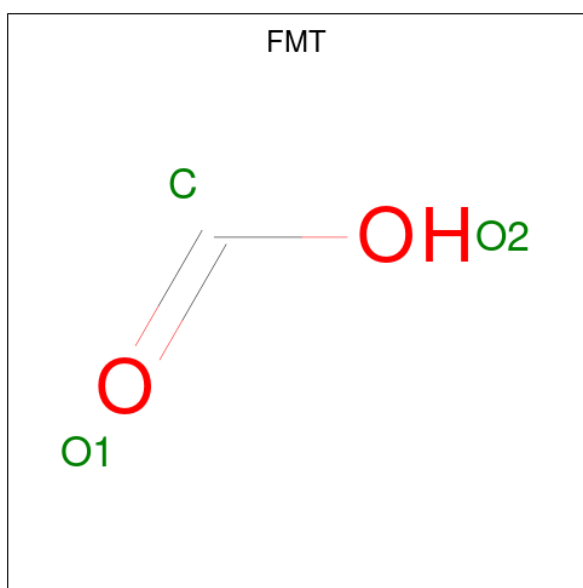
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Mg 1 1	0	0
2	B	1	Total Mg 1 1	0	0
2	C	1	Total Mg 1 1	0	0
2	D	1	Total Mg 1 1	0	0

- Molecule 3 is (5S,6S)-5-[(1-carboxyethenyl)oxy]-6-hydroxycyclohexa-1,3-diene-1-carboxylic acid (CCD ID: ISC) (formula: C₁₀H₁₀O₆).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			16	10	6		
3	B	1	Total	C	O	0	0
			16	10	6		

- Molecule 4 is FORMIC ACID (CCD ID: FMT) (formula: CH_2O_2).



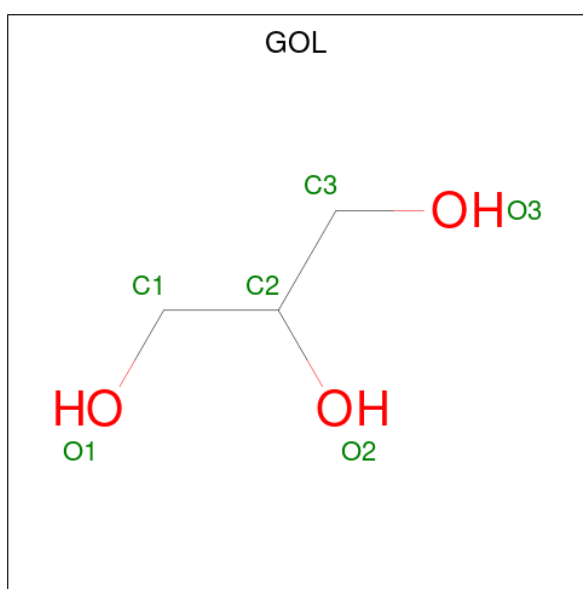
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			3	1	2		
4	B	1	Total	C	O	0	0
			3	1	2		

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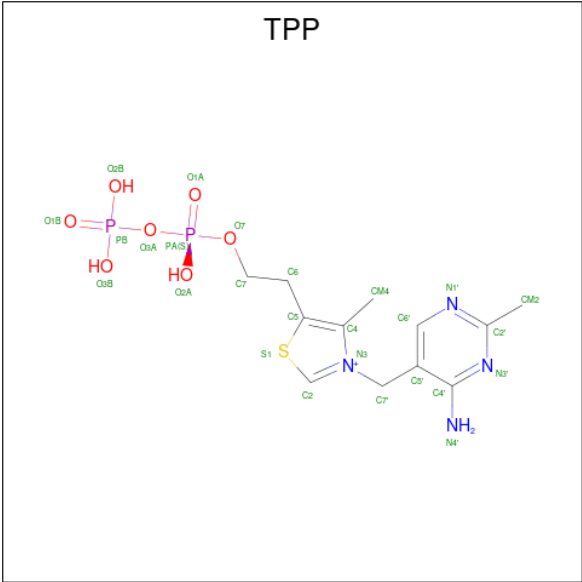
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	B	1	Total	C	O	0	0
			3	1	2		
4	C	1	Total	C	O	0	0
			3	1	2		
4	C	1	Total	C	O	0	0
			3	1	2		
4	C	1	Total	C	O	0	0
			3	1	2		

- Molecule 5 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



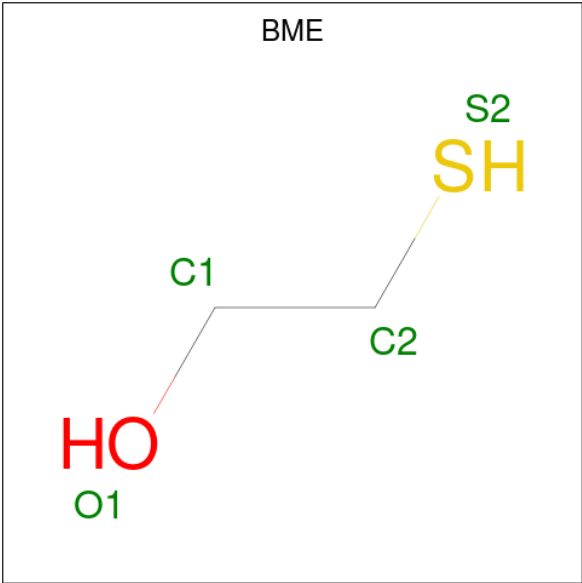
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			6	3	3		
5	A	1	Total	C	O	0	0
			6	3	3		
5	B	1	Total	C	O	0	0
			6	3	3		

- Molecule 6 is THIAMINE DIPHOSPHATE (CCD ID: TPP) (formula: $C_{12}H_{19}N_4O_7P_2S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
6	C	1	Total	C	N	O	P	S	0	0
			26	12	4	7	2	1		
6	D	1	Total	C	N	O	P	S	0	0
			26	12	4	7	2	1		

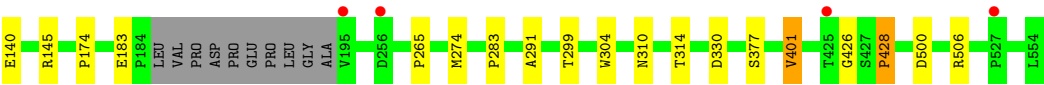
- Molecule 7 is BETA-MERCAPTOETHANOL (CCD ID: BME) (formula: C₂H₆OS).



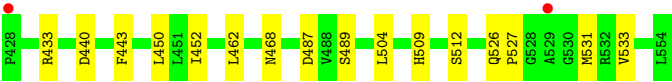
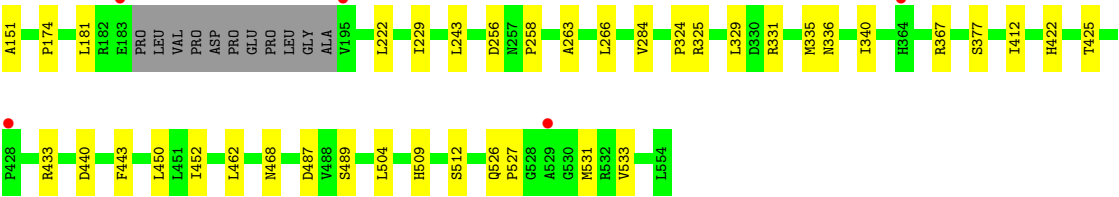
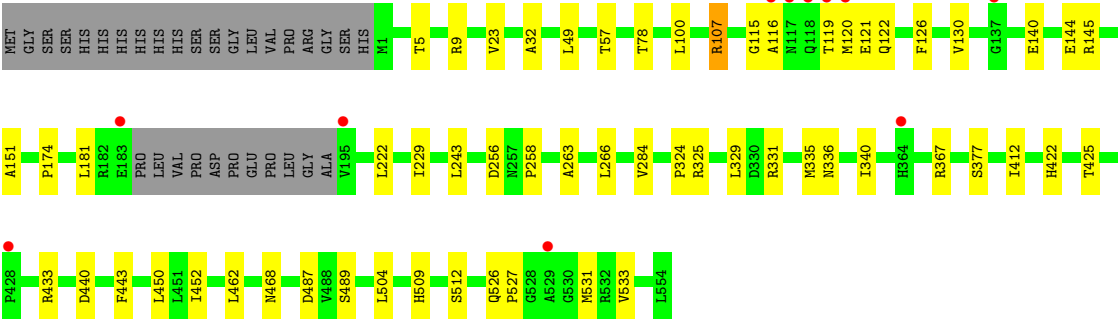
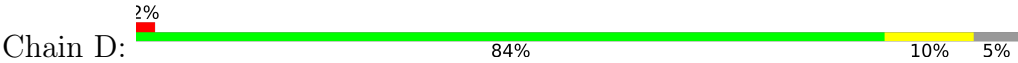
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
7	C	1	Total 4	C 2	O 1	S 1	0	0
7	D	1	Total 4	C 2	O 1	S 1	0	0

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	230	Total 230	O 230	0	0
8	B	200	Total 200	O 200	0	0
8	C	246	Total 246	O 246	0	0
8	D	111	Total 111	O 111	0	0



● Molecule 1: 2-succinyl-5-enolpyruvyl-6-hydroxy-3-cyclohexene-1-carboxylate synthase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	101.44Å 139.59Å 181.77Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.81 – 2.05 19.81 – 2.05	Depositor EDS
% Data completeness (in resolution range)	100.0 (19.81-2.05) 99.8 (19.81-2.05)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.50 (at 2.06Å)	Xtriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.192 , 0.219 0.192 , 0.218	Depositor DCC
R_{free} test set	8144 reflections (4.06%)	wwPDB-VP
Wilson B-factor (Å ²)	40.2	Xtriage
Anisotropy	0.482	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 41.4	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	0.96	EDS
Total number of atoms	16837	wwPDB-VP
Average B, all atoms (Å ²)	47.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.25% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: BME, TPP, GOL, FMT, MG, ISC

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	0.17	0/4043	0.36	0/5532
1	B	0.15	0/4046	0.44	3/5541 (0.1%)
1	C	0.17	0/4107	0.40	0/5621
1	D	0.18	0/4073	0.44	1/5580 (0.0%)
All	All	0.17	0/16269	0.41	4/22274 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	2
1	C	0	1
1	D	0	1
All	All	0	4

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	427	SER	CA-C-N	-9.07	108.51	119.84
1	B	427	SER	C-N-CA	-9.07	108.51	119.84
1	B	429	ASP	N-CA-C	-9.02	94.97	109.76
1	D	116	ALA	N-CA-C	8.10	122.59	111.17

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	427	SER	Peptide
1	B	428	PRO	Peptide
1	C	428	PRO	Peptide
1	D	115	GLY	Peptide

5.2 Too-close contacts

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	3959	0	4001	32	0
1	B	3951	0	4003	35	1
1	C	4020	0	4048	25	1
1	D	3988	0	3997	35	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	16	0	8	0	0
3	B	16	0	8	0	0
4	A	3	0	1	0	0
4	B	6	0	2	0	0
4	C	9	0	3	0	0
5	A	12	0	16	0	0
5	B	6	0	8	2	0
6	C	26	0	16	0	0
6	D	26	0	16	0	0
7	C	4	0	5	2	0
7	D	4	0	5	0	0
8	A	230	0	0	1	0
8	B	200	0	0	0	0
8	C	246	0	0	1	0
8	D	111	0	0	0	0
All	All	16837	0	16137	120	1

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 (120) 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:367:ARG:NH2	1:A:525:ASP:OD1	2.00	0.93
1:A:140:GLU:OE1	1:A:145:ARG:NH1	2.07	0.88
1:D:120:MET:SD	1:D:122:GLN:NE2	2.50	0.84
1:D:526:GLN:NE2	1:D:527:PRO:O	2.13	0.81
1:C:140:GLU:OE2	1:C:145:ARG:NH2	2.13	0.81
1:B:506:ARG:HE	1:C:506:ARG:HH12	1.31	0.79
1:A:39[B]:GLN:OE1	1:A:43[B]:ARG:NH1	2.17	0.76
1:B:377:SER:OG	1:B:378:ASN:N	2.15	0.75
1:C:117:ASN:OD1	1:C:120:MET:N	2.16	0.73
1:C:77:MET:HE3	1:C:86:LEU:HD12	1.71	0.71
1:A:422:HIS:O	1:A:425:THR:OG1	2.07	0.70
1:C:30[B]:ARG:NH1	1:C:183:GLU:OE1	2.27	0.67
1:D:422:HIS:O	1:D:425:THR:OG1	2.12	0.67
1:B:247:ALA:HB3	5:B:605:GOL:H31	1.78	0.65
1:B:282[B]:ARG:HG2	1:B:283:PRO:HD3	1.78	0.65
1:C:33:PRO:HD2	1:C:76:ALA:HB1	1.79	0.63
1:B:470:ASN:O	1:B:540:ARG:NH1	2.32	0.63
1:B:543:LEU:HD12	1:B:546:LEU:HB3	1.82	0.61
1:C:106:ASN:OD1	1:C:120:MET:HE1	2.00	0.61
1:D:140:GLU:OE1	1:D:145:ARG:NH1	2.34	0.60
1:B:282[A]:ARG:HG2	1:B:283:PRO:HD3	1.84	0.59
1:A:145:ARG:NH1	1:B:182:ARG:HH12	2.01	0.58
1:C:30[B]:ARG:NH1	1:C:107:ARG:HE	2.00	0.58
1:A:500:ASP:OD2	1:A:503:ALA:N	2.34	0.58
1:B:523:THR:O	1:B:526:GLN:HG2	2.04	0.58
1:A:487:ASP:OD1	1:A:489:SER:N	2.26	0.57
1:D:107[B]:ARG:NH1	1:D:119:THR:HG21	2.19	0.57
1:D:336:ASN:O	1:D:340:ILE:HG13	2.05	0.57
1:B:1:MET:SD	1:B:9:ARG:NH1	2.77	0.57
1:A:140:GLU:CD	1:A:145:ARG:HH12	2.11	0.57
1:D:256:ASP:O	1:D:258:PRO:HD3	2.06	0.56
1:A:498:ASP:O	1:D:509:HIS:NE2	2.26	0.56
1:A:377:SER:OG	1:A:378:ASN:N	2.39	0.55
1:D:412:ILE:HD13	1:D:452:ILE:HD11	1.89	0.55
1:A:440:ASP:OD2	1:A:497:HIS:NE2	2.35	0.54
1:C:426:GLY:O	1:C:428:PRO:HD3	2.08	0.54
1:B:376:ALA:O	1:B:399:ARG:NH1	2.41	0.54
1:A:469:ASP:O	1:A:540:ARG:NH1	2.42	0.53
1:D:266:LEU:HB3	1:D:335:MET:HE2	1.90	0.53
1:B:354:THR:HG21	1:B:543:LEU:HD13	1.90	0.53
1:B:281:HIS:HB3	1:B:283:PRO:HD2	1.89	0.53
1:D:440:ASP:HB3	1:D:468:ASN:HA	1.91	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:304:TRP:CG	1:C:314:THR:HG21	2.44	0.52
1:D:487:ASP:OD1	1:D:487:ASP:N	2.40	0.51
1:A:183:GLU:H	1:A:183:GLU:CD	2.18	0.51
1:A:377:SER:OG	8:A:701:HOH:O	2.18	0.51
1:D:229:ILE:HD13	1:D:284:VAL:HG13	1.92	0.50
1:B:190:GLU:HA	1:B:191:PRO:C	2.36	0.50
1:B:513:ARG:NH1	1:B:526:GLN:OE1	2.46	0.48
1:A:144:GLU:H	1:A:144:GLU:CD	2.18	0.48
1:A:18:GLY:HA3	1:A:161:LEU:HD13	1.96	0.48
1:B:514:GLN:OE1	1:B:537:LYS:HE3	2.14	0.48
1:D:23:VAL:HB	1:D:49:LEU:HD23	1.95	0.48
1:B:394:ARG:HD3	1:B:418:TYR:CE1	2.48	0.48
1:D:324:PRO:HG2	1:D:329:LEU:HD11	1.95	0.48
1:A:487:ASP:OD1	1:A:488:VAL:N	2.47	0.48
1:C:108:PRO:HG2	1:C:138:LEU:HD22	1.95	0.47
1:B:100:LEU:O	1:B:174:PRO:HA	2.15	0.47
1:D:107[B]:ARG:NH2	1:D:181:LEU:HD21	2.29	0.47
1:C:100:LEU:O	1:C:174:PRO:HA	2.14	0.47
1:D:462:LEU:HD23	1:D:531:MET:HG2	1.96	0.47
1:B:282[A]:ARG:HG3	1:B:282[A]:ARG:HH11	1.80	0.46
1:A:438:ILE:HG22	1:A:439:GLY:O	2.14	0.46
1:A:405:ASP:OD1	1:A:445:HIS:NE2	2.34	0.46
1:B:60:TYR:CG	1:B:406:GLY:HA3	2.51	0.46
1:A:144:GLU:OE1	1:A:144:GLU:N	2.36	0.46
1:B:288:LEU:HB3	1:B:308:SER:HB2	1.98	0.46
1:B:430:SER:HB2	1:B:431:PRO:HD2	1.97	0.46
1:C:91:VAL:HG12	1:C:401:VAL:HG21	1.97	0.46
1:A:60:TYR:CG	1:A:406:GLY:HA3	2.51	0.46
1:C:76:ALA:O	7:C:606:BME:H21	2.16	0.46
1:C:265:PRO:HG3	1:C:283:PRO:HB3	1.97	0.46
1:B:253:ARG:CZ	5:B:605:GOL:H32	2.46	0.45
1:D:450:LEU:O	1:D:452:ILE:HG13	2.16	0.45
1:A:523:THR:O	1:A:526:GLN:HG2	2.16	0.45
1:B:506:ARG:HE	1:C:506:ARG:NH1	2.08	0.45
1:B:282[A]:ARG:HG2	1:B:283:PRO:CD	2.46	0.45
1:D:32:ALA:HA	1:D:78:THR:HG22	1.98	0.45
1:A:394:ARG:NE	1:A:418:TYR:HE1	2.15	0.45
1:C:13:ASP:OD1	1:C:46:ARG:NH1	2.42	0.45
1:A:394:ARG:NE	1:A:418:TYR:CE1	2.85	0.44
1:D:126:PHE:O	1:D:130:VAL:HG22	2.18	0.44
1:D:140:GLU:CD	1:D:145:ARG:HH12	2.25	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:438:ILE:HG23	1:A:442:THR:HB	1.99	0.44
1:B:290:ASP:OD1	1:B:293:VAL:HG23	2.17	0.44
1:D:107[B]:ARG:HH22	1:D:181:LEU:HD21	1.82	0.44
1:D:512:SER:HA	1:D:533:VAL:O	2.18	0.44
1:C:77:MET:HB2	1:C:82:ALA:HB1	1.99	0.44
1:B:144:GLU:OE1	1:B:144:GLU:N	2.28	0.44
1:B:200:ARG:HG2	1:B:206:TRP:HA	2.00	0.44
1:B:222:LEU:HD22	1:B:243:LEU:HD11	1.99	0.43
1:C:274[A]:MET:HE2	1:C:274[A]:MET:HB3	1.85	0.43
1:D:263:ALA:HA	1:D:266:LEU:HD12	1.99	0.43
1:D:367:ARG:NE	1:D:433:ARG:HH22	2.15	0.43
1:A:76:ALA:HA	1:A:103:LEU:O	2.18	0.43
1:B:282[A]:ARG:HH11	1:B:282[A]:ARG:CG	2.32	0.43
1:C:291:ALA:HA	1:C:310:ASN:OD1	2.19	0.43
1:C:86:LEU:HD11	7:C:606:BME:H11	2.01	0.42
1:A:543:LEU:HD23	1:A:543:LEU:HA	1.81	0.42
1:C:107:ARG:HG2	1:C:107:ARG:HH11	1.83	0.42
1:D:222:LEU:HD22	1:D:243:LEU:HD11	2.01	0.42
1:D:331:ARG:O	1:D:335:MET:HG2	2.19	0.42
1:D:325:ARG:O	1:D:329:LEU:HD12	2.19	0.42
1:D:526:GLN:HA	1:D:527:PRO:HD3	1.83	0.42
1:A:95:TYR:OH	1:D:121:GLU:OE2	2.35	0.42
1:B:309:GLY:O	1:D:151:ALA:HB1	2.19	0.42
1:C:299:THR:HG23	8:C:708:HOH:O	2.19	0.42
1:D:144:GLU:OE1	1:D:144:GLU:N	2.37	0.42
1:A:195:VAL:O	1:A:195:VAL:HG13	2.20	0.42
1:A:100:LEU:O	1:A:174:PRO:HA	2.20	0.41
1:A:437:LEU:C	1:A:438:ILE:HD12	2.45	0.41
1:B:282[B]:ARG:HG2	1:B:283:PRO:CD	2.48	0.41
1:B:507:ALA:HA	1:C:500:ASP:HB3	2.00	0.41
1:B:441:LEU:HD23	1:B:441:LEU:HA	1.78	0.41
1:D:5:THR:HG22	1:D:9:ARG:NH2	2.36	0.41
1:C:23:VAL:HG22	1:C:74:CYS:HB2	2.03	0.41
1:A:513:ARG:HE	1:A:513:ARG:HB2	1.65	0.40
1:B:200:ARG:CG	1:B:206:TRP:HA	2.51	0.40
1:D:100:LEU:O	1:D:174:PRO:HA	2.21	0.40
1:D:443:PHE:HE2	1:D:504:LEU:HD23	1.86	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:344:ARG:NH1	1:C:330:ASP:OD2[2_654]	2.08	0.12

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	527/574 (92%)	519 (98%)	8 (2%)	0	100	100
1	B	532/574 (93%)	520 (98%)	12 (2%)	0	100	100
1	C	542/574 (94%)	530 (98%)	12 (2%)	0	100	100
1	D	542/574 (94%)	527 (97%)	15 (3%)	0	100	100
All	All	2143/2296 (93%)	2096 (98%)	47 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	419/445 (94%)	418 (100%)	1 (0%)	87	91
1	B	418/445 (94%)	415 (99%)	3 (1%)	76	80
1	C	422/445 (95%)	417 (99%)	5 (1%)	63	65
1	D	416/445 (94%)	411 (99%)	5 (1%)	63	65
All	All	1675/1780 (94%)	1661 (99%)	14 (1%)	76	77

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	383	VAL
1	B	282[A]	ARG
1	B	282[B]	ARG
1	B	377	SER
1	C	30[A]	ARG
1	C	30[B]	ARG
1	C	57	THR
1	C	377	SER
1	C	401	VAL
1	D	57	THR
1	D	107[A]	ARG
1	D	107[B]	ARG
1	D	377	SER
1	D	489	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	117	ASN
1	B	514	GLN
1	B	545	GLN
1	C	216	GLN
1	C	422	HIS
1	D	270	GLN
1	D	312	GLN
1	D	422	HIS
1	D	526	GLN
1	D	547	HIS

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 19 ligands modelled in this entry, 4 are monoatomic - leaving 15 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	GOL	A	605	-	5,5,5	0.36	0	5,5,5	0.49	0
3	ISC	B	602	-	15,16,16	1.61	3 (20%)	15,22,22	1.30	1 (6%)
4	FMT	C	602	-	2,2,2	0.63	0	1,1,1	0.70	0
4	FMT	C	603	-	2,2,2	0.66	0	1,1,1	0.62	0
6	TPP	C	605	2	26,27,27	1.74	4 (15%)	38,40,40	1.68	8 (21%)
5	GOL	B	605	-	5,5,5	0.39	0	5,5,5	0.44	0
7	BME	D	603	1	3,3,3	0.62	0	2,2,2	0.70	0
6	TPP	D	602	2	26,27,27	1.75	4 (15%)	38,40,40	1.68	8 (21%)
3	ISC	A	602	-	15,16,16	1.64	3 (20%)	15,22,22	1.09	1 (6%)
4	FMT	B	603	-	2,2,2	0.66	0	1,1,1	0.63	0
4	FMT	A	603	-	2,2,2	0.64	0	1,1,1	0.66	0
4	FMT	B	604	2	2,2,2	0.66	0	1,1,1	0.63	0
5	GOL	A	604	-	5,5,5	0.40	0	5,5,5	0.41	0
4	FMT	C	604	-	2,2,2	0.65	0	1,1,1	0.67	0
7	BME	C	606	1	3,3,3	0.63	0	2,2,2	0.79	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	GOL	A	605	-	-	0/4/4/4	-
3	ISC	B	602	-	-	1/10/26/26	0/1/1/1
5	GOL	B	605	-	-	2/4/4/4	-
7	BME	D	603	1	-	1/1/1/1	-
6	TPP	D	602	2	-	2/17/17/17	0/2/2/2
3	ISC	A	602	-	-	0/10/26/26	0/1/1/1
6	TPP	C	605	2	-	1/17/17/17	0/2/2/2
5	GOL	A	604	-	-	0/4/4/4	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
7	BME	C	606	1	-	1/1/1/1	-

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	D	602	TPP	C5-C4	6.62	1.49	1.35
6	C	605	TPP	C5-C4	6.53	1.49	1.35
6	C	605	TPP	C5'-C4'	3.63	1.48	1.42
6	D	602	TPP	C5'-C4'	3.53	1.48	1.42
3	A	602	ISC	O3'-C2'	3.11	1.46	1.36
3	B	602	ISC	O3'-C2'	3.09	1.46	1.36
3	A	602	ISC	C2'-C1'	-2.97	1.46	1.49
3	B	602	ISC	C2'-C1'	-2.91	1.46	1.49
6	D	602	TPP	PA-O3A	2.37	1.62	1.59
6	C	605	TPP	PA-O3A	2.31	1.62	1.59
6	C	605	TPP	C4-N3	-2.20	1.35	1.39
6	D	602	TPP	C4-N3	-2.11	1.35	1.39
3	A	602	ISC	O2-C	-2.03	1.25	1.30
3	B	602	ISC	O1'-C1'	-2.02	1.25	1.30

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
6	C	605	TPP	C2-S1-C5	-4.63	88.15	91.22
6	D	602	TPP	C2-S1-C5	-4.39	88.30	91.22
6	D	602	TPP	C6'-N1'-C2'	4.07	122.75	116.07
6	C	605	TPP	C6'-N1'-C2'	3.98	122.60	116.07
3	B	602	ISC	O1'-C1'-C2'	2.93	118.91	113.91
6	D	602	TPP	C5'-C6'-N1'	-2.91	119.11	123.83
6	C	605	TPP	C5'-C6'-N1'	-2.78	119.31	123.83
3	A	602	ISC	O1'-C1'-C2'	2.72	118.54	113.91
6	D	602	TPP	S1-C2-N3	2.71	115.72	112.30
6	C	605	TPP	C6-C5-S1	-2.67	114.65	120.90
6	C	605	TPP	S1-C2-N3	2.63	115.63	112.30
6	C	605	TPP	N4'-C4'-N3'	2.62	120.56	117.03
6	D	602	TPP	N4'-C4'-N3'	2.59	120.53	117.03
6	D	602	TPP	N1'-C2'-N3'	-2.45	121.45	125.53
6	C	605	TPP	N1'-C2'-N3'	-2.45	121.45	125.53
6	D	602	TPP	C6-C5-S1	-2.30	115.52	120.90
6	C	605	TPP	C6-C5-C4	2.08	133.38	128.17
6	D	602	TPP	CM4-C4-N3	2.06	125.33	120.57

There are no chirality outliers.

All (8) torsion outliers are listed below:

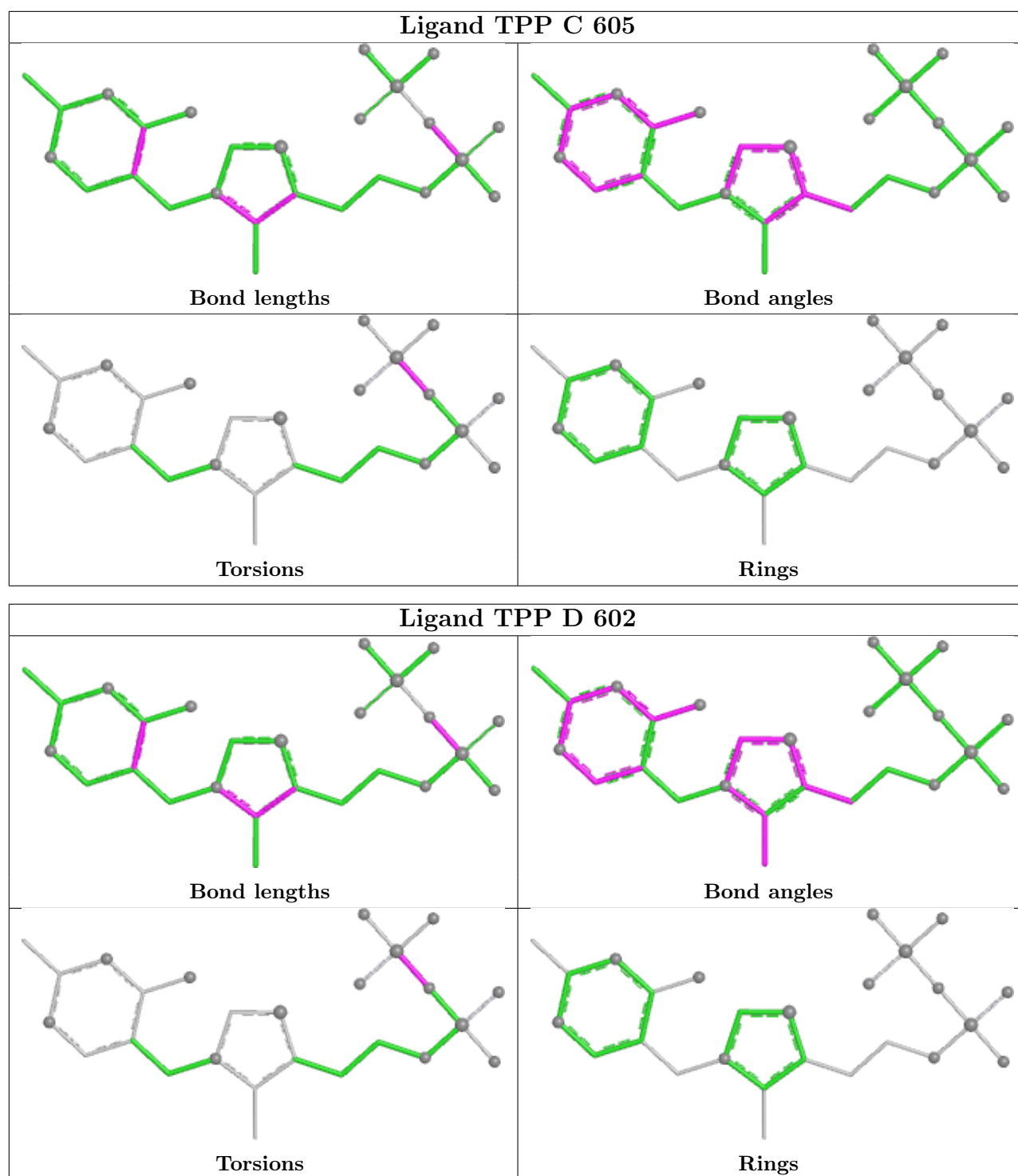
Mol	Chain	Res	Type	Atoms
5	B	605	GOL	C1-C2-C3-O3
6	C	605	TPP	PA-O3A-PB-O2B
6	D	602	TPP	PA-O3A-PB-O2B
7	C	606	BME	O1-C1-C2-S2
7	D	603	BME	O1-C1-C2-S2
5	B	605	GOL	O2-C2-C3-O3
3	B	602	ISC	O2-C-C1-C6
6	D	602	TPP	PA-O3A-PB-O1B

There are no ring outliers.

2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	605	GOL	2	0
7	C	606	BME	2	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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	529/574 (92%)	-0.13	6 (1%) 78 80	17, 42, 69, 102	8 (1%)
1	B	535/574 (93%)	-0.04	11 (2%) 63 65	22, 43, 73, 110	5 (0%)
1	C	543/574 (94%)	-0.14	8 (1%) 72 73	17, 41, 68, 96	3 (0%)
1	D	543/574 (94%)	0.24	11 (2%) 65 67	20, 52, 77, 111	3 (0%)
All	All	2150/2296 (93%)	-0.02	36 (1%) 69 70	17, 45, 74, 111	19 (0%)

All (36) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	119	THR	4.0
1	D	116	ALA	3.1
1	B	471	GLY	3.0
1	A	428	PRO	3.0
1	B	190	GLU	3.0
1	B	191	PRO	3.0
1	B	529	ALA	2.8
1	B	291	ALA	2.7
1	B	428	PRO	2.7
1	B	543	LEU	2.6
1	D	137	GLY	2.6
1	D	119	THR	2.6
1	B	352	LEU	2.6
1	C	425	THR	2.5
1	B	404	ILE	2.4
1	D	195	VAL	2.4
1	A	527	PRO	2.4
1	C	116	ALA	2.3
1	A	425	THR	2.3
1	D	183	GLU	2.3
1	D	120	MET	2.2

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Mol	Chain	Res	Type	RSRZ
1	D	118	GLN	2.2
1	B	496	PRO	2.2
1	C	118	GLN	2.2
1	D	364	HIS	2.2
1	A	189	PRO	2.2
1	C	120	MET	2.2
1	C	195	VAL	2.1
1	D	529	ALA	2.1
1	C	256	ASP	2.1
1	C	527	PRO	2.1
1	A	1	MET	2.1
1	D	117	ASN	2.1
1	B	425	THR	2.1
1	A	493	PHE	2.1
1	D	428	PRO	2.0

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [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
7	BME	C	606	4/4	0.73	0.20	48,54,56,73	0
4	FMT	B	604	3/3	0.80	0.12	51,51,55,61	0
3	ISC	A	602	16/16	0.80	0.12	48,66,72,74	0
4	FMT	C	603	3/3	0.83	0.13	56,56,60,71	0
4	FMT	C	604	3/3	0.84	0.10	43,43,54,57	0
4	FMT	C	602	3/3	0.85	0.12	38,38,46,48	0
5	GOL	B	605	6/6	0.85	0.12	50,55,59,62	0
4	FMT	B	603	3/3	0.85	0.13	51,51,55,57	0

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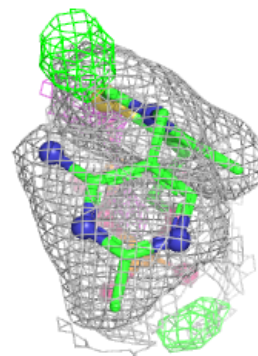
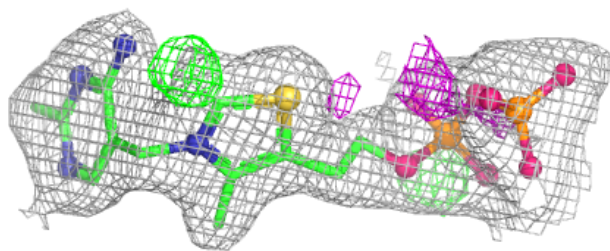
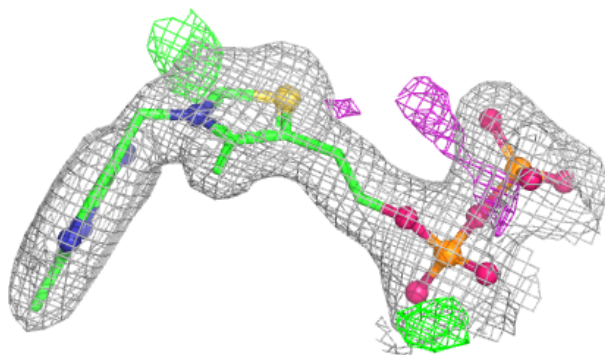
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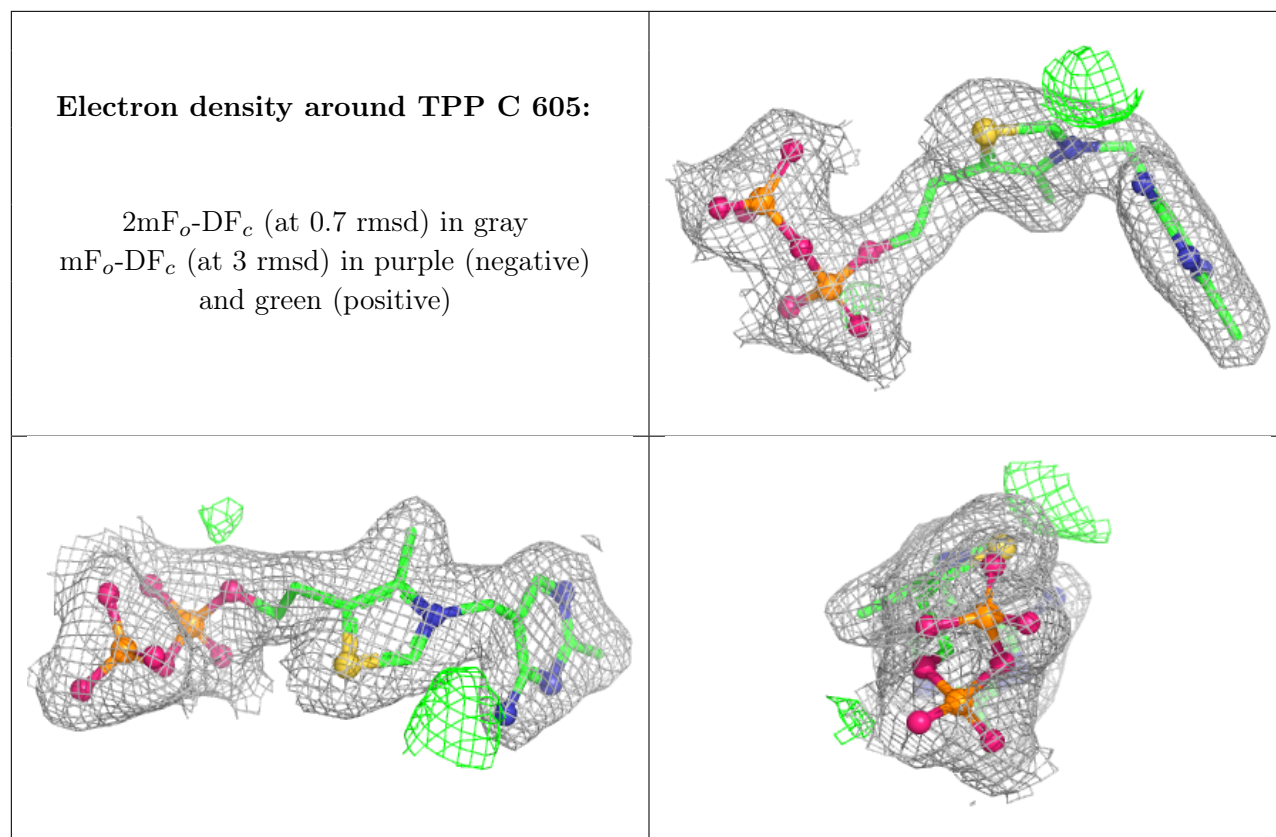
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
5	GOL	A	604	6/6	0.87	0.13	44,51,52,57	0
4	FMT	A	603	3/3	0.89	0.11	45,45,46,46	0
5	GOL	A	605	6/6	0.90	0.12	48,56,62,66	0
3	ISC	B	602	16/16	0.91	0.09	38,51,59,63	0
7	BME	D	603	4/4	0.94	0.12	56,57,61,61	0
6	TPP	D	602	26/26	0.95	0.07	39,46,52,56	0
2	MG	B	601	1/1	0.97	0.10	52,52,52,52	0
6	TPP	C	605	26/26	0.98	0.04	25,33,35,35	0
2	MG	C	601	1/1	0.98	0.03	32,32,32,32	0
2	MG	D	601	1/1	0.99	0.03	42,42,42,42	0
2	MG	A	601	1/1	0.99	0.06	50,50,50,50	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 TPP D 602:

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.