



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 04:10 AM UTC

PDB ID : 4QQ8 / pdb_00004qq8
Title : Crystal structure of the formolase FLS in space group P 43 21 2
Authors : Shen, B.W.; Siegel, J.B.; Stoddard, B.L.
Deposited on : 2014-06-26
Resolution : 2.88 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

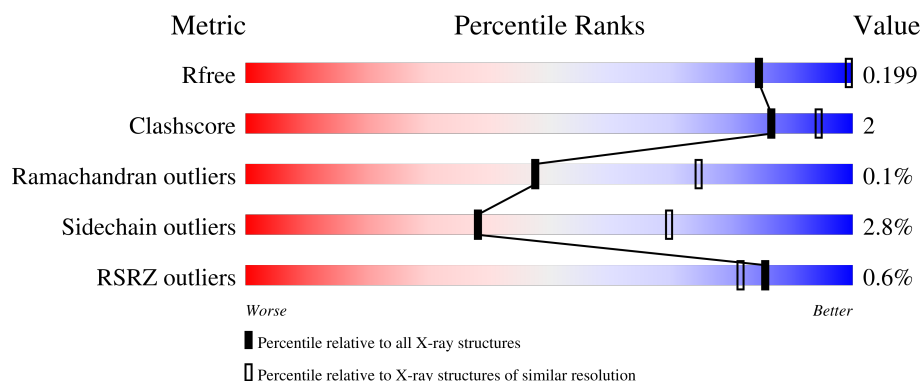
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.88 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	3557 (2.90-2.86)
Clashscore	190562	3801 (2.90-2.86)
Ramachandran outliers	187476	3699 (2.90-2.86)
Sidechain outliers	187428	3702 (2.90-2.86)
RSRZ outliers	180081	3558 (2.90-2.86)

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	583	% 91% 6% .
1	B	583	% 89% 7% ..
1	C	583	% 90% 7% ..
1	D	583	% 91% 6% .

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 16915 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 Formolase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	563	Total	C	N	O	S	0	1	0
			4163	2629	739	778	17			
1	B	563	Total	C	N	O	S	0	1	0
			4163	2629	739	778	17			
1	C	569	Total	C	N	O	S	0	0	0
			4202	2654	742	789	17			
1	D	569	Total	C	N	O	S	0	1	0
			4213	2660	746	790	17			

There are 108 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	28	ILE	ALA	conflict	UNP Q9F4L3
A	89	ARG	TRP	conflict	UNP Q9F4L3
A	90	THR	LEU	conflict	UNP Q9F4L3
A	188	HIS	ARG	conflict	UNP Q9F4L3
A	394	GLY	ALA	conflict	UNP Q9F4L3
A	419	ASN	GLY	conflict	UNP Q9F4L3
A	480	TRP	ALA	conflict	UNP Q9F4L3
A	564	GLY	-	expression tag	UNP Q9F4L3
A	565	SER	-	expression tag	UNP Q9F4L3
A	566	THR	-	expression tag	UNP Q9F4L3
A	567	GLU	-	expression tag	UNP Q9F4L3
A	568	ASN	-	expression tag	UNP Q9F4L3
A	569	LEU	-	expression tag	UNP Q9F4L3
A	570	TYR	-	expression tag	UNP Q9F4L3
A	571	PHE	-	expression tag	UNP Q9F4L3
A	572	GLN	-	expression tag	UNP Q9F4L3
A	573	SER	-	expression tag	UNP Q9F4L3
A	574	GLY	-	expression tag	UNP Q9F4L3
A	575	ALA	-	expression tag	UNP Q9F4L3
A	576	LEU	-	expression tag	UNP Q9F4L3
A	577	GLU	-	expression tag	UNP Q9F4L3

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Chain	Residue	Modelled	Actual	Comment	Reference
A	578	HIS	-	expression tag	UNP Q9F4L3
A	579	HIS	-	expression tag	UNP Q9F4L3
A	580	HIS	-	expression tag	UNP Q9F4L3
A	581	HIS	-	expression tag	UNP Q9F4L3
A	582	HIS	-	expression tag	UNP Q9F4L3
A	583	HIS	-	expression tag	UNP Q9F4L3
B	28	ILE	ALA	conflict	UNP Q9F4L3
B	89	ARG	TRP	conflict	UNP Q9F4L3
B	90	THR	LEU	conflict	UNP Q9F4L3
B	188	HIS	ARG	conflict	UNP Q9F4L3
B	394	GLY	ALA	conflict	UNP Q9F4L3
B	419	ASN	GLY	conflict	UNP Q9F4L3
B	480	TRP	ALA	conflict	UNP Q9F4L3
B	564	GLY	-	expression tag	UNP Q9F4L3
B	565	SER	-	expression tag	UNP Q9F4L3
B	566	THR	-	expression tag	UNP Q9F4L3
B	567	GLU	-	expression tag	UNP Q9F4L3
B	568	ASN	-	expression tag	UNP Q9F4L3
B	569	LEU	-	expression tag	UNP Q9F4L3
B	570	TYR	-	expression tag	UNP Q9F4L3
B	571	PHE	-	expression tag	UNP Q9F4L3
B	572	GLN	-	expression tag	UNP Q9F4L3
B	573	SER	-	expression tag	UNP Q9F4L3
B	574	GLY	-	expression tag	UNP Q9F4L3
B	575	ALA	-	expression tag	UNP Q9F4L3
B	576	LEU	-	expression tag	UNP Q9F4L3
B	577	GLU	-	expression tag	UNP Q9F4L3
B	578	HIS	-	expression tag	UNP Q9F4L3
B	579	HIS	-	expression tag	UNP Q9F4L3
B	580	HIS	-	expression tag	UNP Q9F4L3
B	581	HIS	-	expression tag	UNP Q9F4L3
B	582	HIS	-	expression tag	UNP Q9F4L3
B	583	HIS	-	expression tag	UNP Q9F4L3
C	28	ILE	ALA	conflict	UNP Q9F4L3
C	89	ARG	TRP	conflict	UNP Q9F4L3
C	90	THR	LEU	conflict	UNP Q9F4L3
C	188	HIS	ARG	conflict	UNP Q9F4L3
C	394	GLY	ALA	conflict	UNP Q9F4L3
C	419	ASN	GLY	conflict	UNP Q9F4L3
C	480	TRP	ALA	conflict	UNP Q9F4L3
C	564	GLY	-	expression tag	UNP Q9F4L3
C	565	SER	-	expression tag	UNP Q9F4L3

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Chain	Residue	Modelled	Actual	Comment	Reference
C	566	THR	-	expression tag	UNP Q9F4L3
C	567	GLU	-	expression tag	UNP Q9F4L3
C	568	ASN	-	expression tag	UNP Q9F4L3
C	569	LEU	-	expression tag	UNP Q9F4L3
C	570	TYR	-	expression tag	UNP Q9F4L3
C	571	PHE	-	expression tag	UNP Q9F4L3
C	572	GLN	-	expression tag	UNP Q9F4L3
C	573	SER	-	expression tag	UNP Q9F4L3
C	574	GLY	-	expression tag	UNP Q9F4L3
C	575	ALA	-	expression tag	UNP Q9F4L3
C	576	LEU	-	expression tag	UNP Q9F4L3
C	577	GLU	-	expression tag	UNP Q9F4L3
C	578	HIS	-	expression tag	UNP Q9F4L3
C	579	HIS	-	expression tag	UNP Q9F4L3
C	580	HIS	-	expression tag	UNP Q9F4L3
C	581	HIS	-	expression tag	UNP Q9F4L3
C	582	HIS	-	expression tag	UNP Q9F4L3
C	583	HIS	-	expression tag	UNP Q9F4L3
D	28	ILE	ALA	conflict	UNP Q9F4L3
D	89	ARG	TRP	conflict	UNP Q9F4L3
D	90	THR	LEU	conflict	UNP Q9F4L3
D	188	HIS	ARG	conflict	UNP Q9F4L3
D	394	GLY	ALA	conflict	UNP Q9F4L3
D	419	ASN	GLY	conflict	UNP Q9F4L3
D	480	TRP	ALA	conflict	UNP Q9F4L3
D	564	GLY	-	expression tag	UNP Q9F4L3
D	565	SER	-	expression tag	UNP Q9F4L3
D	566	THR	-	expression tag	UNP Q9F4L3
D	567	GLU	-	expression tag	UNP Q9F4L3
D	568	ASN	-	expression tag	UNP Q9F4L3
D	569	LEU	-	expression tag	UNP Q9F4L3
D	570	TYR	-	expression tag	UNP Q9F4L3
D	571	PHE	-	expression tag	UNP Q9F4L3
D	572	GLN	-	expression tag	UNP Q9F4L3
D	573	SER	-	expression tag	UNP Q9F4L3
D	574	GLY	-	expression tag	UNP Q9F4L3
D	575	ALA	-	expression tag	UNP Q9F4L3
D	576	LEU	-	expression tag	UNP Q9F4L3
D	577	GLU	-	expression tag	UNP Q9F4L3
D	578	HIS	-	expression tag	UNP Q9F4L3
D	579	HIS	-	expression tag	UNP Q9F4L3
D	580	HIS	-	expression tag	UNP Q9F4L3

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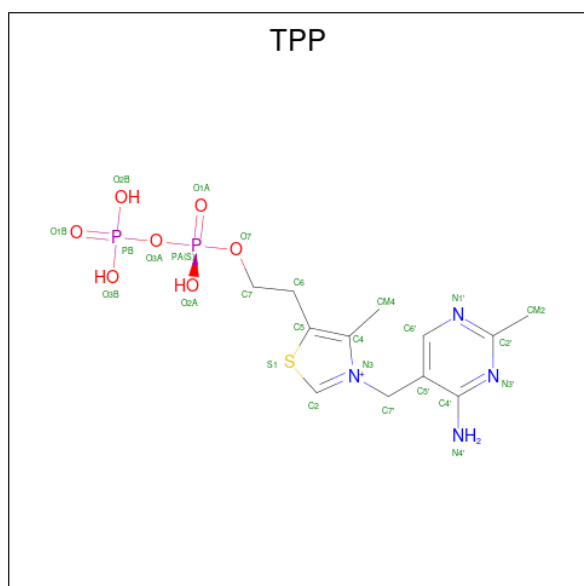
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Chain	Residue	Modelled	Actual	Comment	Reference
D	581	HIS	-	expression tag	UNP Q9F4L3
D	582	HIS	-	expression tag	UNP Q9F4L3
D	583	HIS	-	expression tag	UNP Q9F4L3

- 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 THIAMINE DIPHOSPHATE (CCD ID: TPP) (formula: C₁₂H₁₉N₄O₇P₂S).



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

- Molecule 4 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: $C_2H_6O_2$).



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

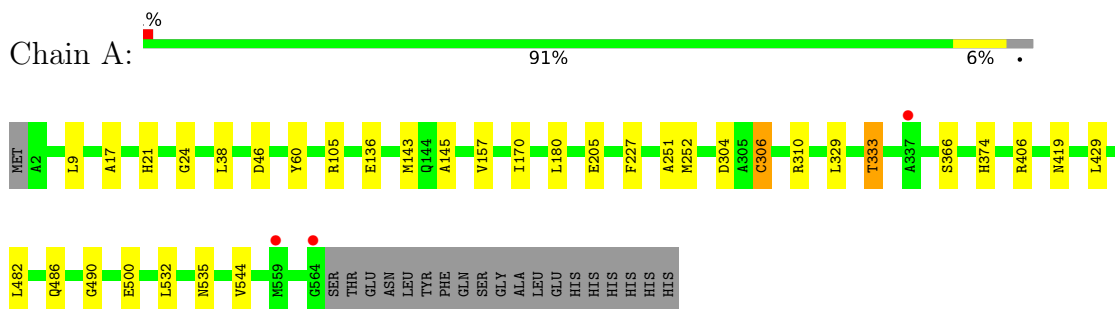
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	33	Total	O	0	0
			33	33		
5	B	4	Total	O	0	0
			4	4		
5	C	9	Total	O	0	0
			9	9		
5	D	4	Total	O	0	0
			4	4		

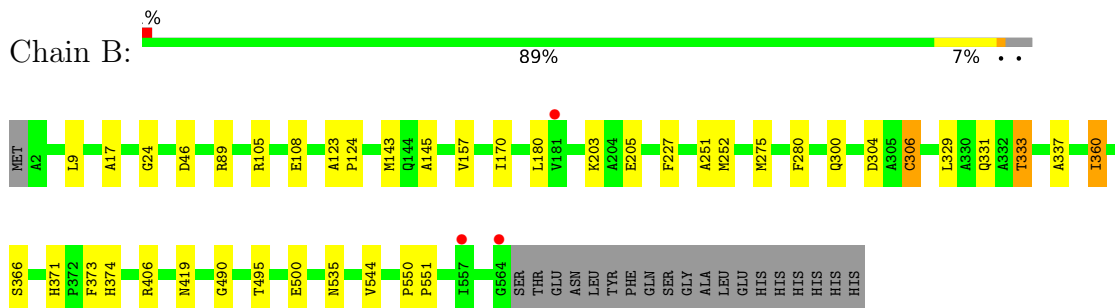
3 Residue-property plots [i](#)

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.

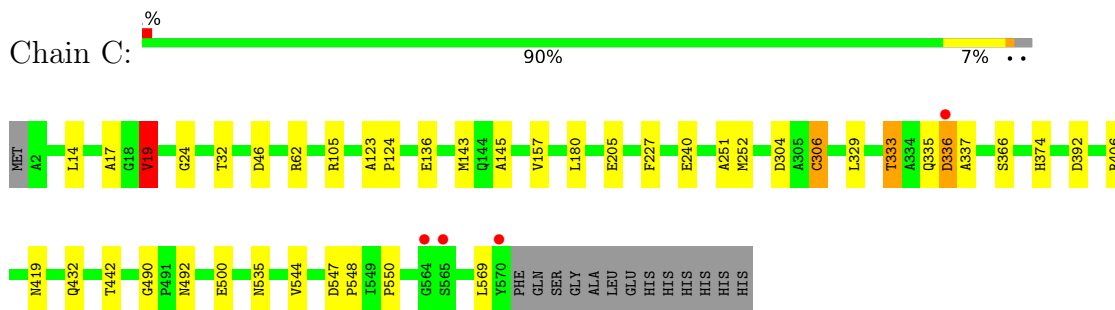
- Molecule 1: Formolase



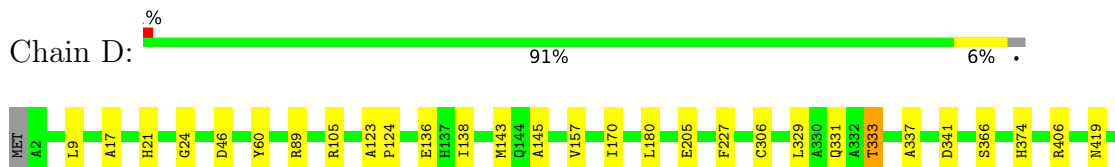
- Molecule 1: Formolase

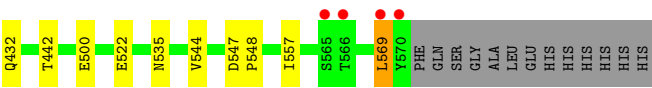


- Molecule 1: Formolase



- Molecule 1: Formolase





4 Data and refinement statistics

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α , β , γ	144.74Å 144.74Å 269.55Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	127.52 – 2.88 127.52 – 2.88	Depositor EDS
% Data completeness (in resolution range)	97.8 (127.52-2.88) 97.8 (127.52-2.88)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.73 (at 2.86Å)	Xtriage
Refinement program	REFMAC 5.8.0071	Depositor
R, R_{free}	0.169 , 0.199 0.173 , 0.199	Depositor DCC
R_{free} test set	3185 reflections (4.86%)	wwPDB-VP
Wilson B-factor (Å ²)	55.6	Xtriage
Anisotropy	0.142	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 37.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	16915	wwPDB-VP
Average B, all atoms (Å ²)	54.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.55% 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: EDO, MG, TPP

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	0.87	0/4249	0.95	2/5794 (0.0%)
1	B	0.83	0/4249	0.95	4/5794 (0.1%)
1	C	0.90	0/4289	0.97	7/5850 (0.1%)
1	D	0.86	1/4300 (0.0%)	0.96	1/5864 (0.0%)
All	All	0.87	1/17087 (0.0%)	0.96	14/23302 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	138	ILE	CA-CB	-5.44	1.51	1.54

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	341	ASP	N-CA-C	6.87	118.46	110.97
1	C	336	ASP	N-CA-C	-6.13	103.34	111.24
1	C	335	GLN	CB-CA-C	-6.10	99.62	111.03
1	C	550	PRO	O-C-N	5.96	123.95	121.15
1	A	490	GLY	CA-C-N	5.89	127.20	119.84
1	A	490	GLY	C-N-CA	5.89	127.20	119.84
1	B	550	PRO	O-C-N	5.62	123.79	121.15
1	C	490	GLY	CA-C-N	5.47	126.68	119.84
1	C	490	GLY	C-N-CA	5.47	126.68	119.84
1	C	19	VAL	N-CA-CB	5.42	116.98	110.31
1	B	490	GLY	CA-C-N	5.30	126.46	119.84
1	B	490	GLY	C-N-CA	5.30	126.46	119.84
1	C	392	ASP	N-CA-C	-5.08	101.69	108.34
1	B	360	ILE	CB-CA-C	-5.03	105.43	112.02

There are no chirality outliers.

There are no planarity outliers.

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	4163	0	4148	16	0
1	B	4163	0	4148	23	0
1	C	4202	0	4180	18	0
1	D	4213	0	4192	16	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	26	0	16	0	0
3	B	26	0	16	0	0
3	C	26	0	16	0	0
3	D	26	0	16	0	0
4	A	8	0	12	0	0
4	C	4	0	6	0	0
4	D	4	0	6	0	0
5	A	33	0	0	0	0
5	B	4	0	0	1	0
5	C	9	0	0	0	0
5	D	4	0	0	1	0
All	All	16915	0	16756	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 2.

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:B:17:ALA:HB2	1:B:143:MET:HE1	1.54	0.90
1:A:17:ALA:HB2	1:A:143:MET:HE1	1.53	0.88
1:D:17:ALA:HB2	1:D:143:MET:HE1	1.55	0.88
1:C:17:ALA:HB2	1:C:143:MET:HE1	1.54	0.86
1:B:371:HIS:HD2	1:B:373:PHE:H	1.29	0.77

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:9:LEU:HD11	1:B:170:ILE:HD11	1.69	0.72
1:D:9:LEU:HD11	1:D:170:ILE:HD11	1.71	0.71
1:A:9:LEU:HD11	1:A:170:ILE:HD11	1.71	0.71
1:C:329:LEU:O	1:C:333:THR:HB	1.94	0.68
1:B:329:LEU:O	1:B:333:THR:HB	1.94	0.67
1:A:329:LEU:O	1:A:333:THR:HB	1.95	0.66
1:B:360:ILE:HD11	1:B:551:PRO:HG2	1.77	0.66
1:B:275:MET:HE3	1:B:300:GLN:HG3	1.79	0.65
1:D:329:LEU:O	1:D:333:THR:HB	1.96	0.64
1:A:38:LEU:HD13	1:B:495:THR:HG21	1.80	0.62
1:B:371:HIS:CD2	1:B:373:PHE:H	2.19	0.55
1:C:336:ASP:OD1	1:C:337:ALA:N	2.31	0.55
1:B:89[A]:ARG:HD2	5:B:701:HOH:O	2.07	0.55
1:B:143:MET:HE3	1:B:143:MET:HA	1.91	0.53
1:B:366:SER:OG	1:B:374:HIS:HD2	1.92	0.53
1:C:62:ARG:NH2	1:C:240:GLU:OE2	2.42	0.52
1:D:143:MET:HE3	1:D:143:MET:HA	1.91	0.52
1:C:143:MET:HE3	1:C:143:MET:HA	1.91	0.52
1:A:366:SER:OG	1:A:374:HIS:HD2	1.93	0.51
1:D:89[A]:ARG:HD2	5:D:701:HOH:O	2.09	0.51
1:A:143:MET:HE3	1:A:143:MET:HA	1.93	0.51
1:D:366:SER:OG	1:D:374:HIS:HD2	1.94	0.49
1:B:275:MET:HE3	1:B:300:GLN:CG	2.42	0.49
1:A:310:ARG:NH2	1:B:108:GLU:OE2	2.46	0.49
1:C:366:SER:OG	1:C:374:HIS:HD2	1.95	0.48
1:B:304:ASP:OD1	1:B:306:CYS:SG	2.71	0.48
1:D:21:HIS:HD2	1:D:60:TYR:OH	1.96	0.48
1:B:275:MET:HE1	1:B:280:PHE:CE2	2.50	0.46
1:D:123:ALA:N	1:D:124:PRO:CD	2.78	0.46
1:D:557:ILE:O	1:D:569:LEU:CD1	2.63	0.46
1:A:304:ASP:OD1	1:A:306:CYS:SG	2.72	0.46
1:D:123:ALA:N	1:D:124:PRO:HD2	2.31	0.46
1:C:143:MET:HE2	1:C:180:LEU:HD13	1.96	0.46
1:B:145:ALA:HB1	1:B:157:VAL:HG11	1.98	0.46
1:A:145:ALA:HB1	1:A:157:VAL:HG11	1.97	0.45
1:B:360:ILE:CD1	1:B:551:PRO:HG2	2.46	0.45
1:D:24:GLY:O	1:D:46:ASP:HA	2.17	0.45
1:A:143:MET:HE2	1:A:180:LEU:HD13	1.98	0.45
1:A:24:GLY:O	1:A:46:ASP:HA	2.17	0.45
1:C:14:LEU:O	1:C:19:VAL:HG13	2.17	0.45
1:C:123:ALA:N	1:C:124:PRO:CD	2.79	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:145:ALA:HB1	1:D:157:VAL:HG11	1.99	0.45
1:C:123:ALA:N	1:C:124:PRO:HD2	2.32	0.44
1:D:143:MET:HE2	1:D:180:LEU:HD13	1.98	0.44
1:A:482:LEU:O	1:A:486:GLN:HG2	2.18	0.44
1:B:123:ALA:N	1:B:124:PRO:HD2	2.32	0.44
1:C:251:ALA:HB3	1:C:252:MET:HE3	2.00	0.43
1:B:123:ALA:N	1:B:124:PRO:CD	2.80	0.43
1:B:24:GLY:O	1:B:46:ASP:HA	2.19	0.43
1:B:143:MET:HE2	1:B:180:LEU:HD13	2.00	0.43
1:C:492:ASN:OD1	1:C:492:ASN:N	2.51	0.43
1:C:432:GLN:HE22	1:C:442:THR:H	1.67	0.43
1:C:24:GLY:O	1:C:46:ASP:HA	2.18	0.42
1:C:304:ASP:OD1	1:C:306:CYS:SG	2.73	0.42
1:A:429:LEU:C	1:A:429:LEU:HD23	2.45	0.42
1:D:547:ASP:N	1:D:548:PRO:CD	2.82	0.42
1:C:227:PHE:HA	1:C:333:THR:HG21	2.02	0.42
1:C:145:ALA:HB1	1:C:157:VAL:HG11	2.01	0.42
1:D:227:PHE:HA	1:D:333:THR:HG21	2.02	0.42
1:A:251:ALA:HB3	1:A:252:MET:HE3	2.02	0.42
1:C:547:ASP:N	1:C:548:PRO:CD	2.82	0.42
1:A:21:HIS:HD2	1:A:60:TYR:OH	2.02	0.41
1:B:227:PHE:HA	1:B:333:THR:HG21	2.02	0.41
1:A:227:PHE:HA	1:A:333:THR:HG21	2.02	0.41
1:B:251:ALA:HB3	1:B:252:MET:HE3	2.02	0.41
1:D:432:GLN:HE22	1:D:442:THR:H	1.69	0.41

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	562/583 (96%)	543 (97%)	19 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	562/583 (96%)	544 (97%)	17 (3%)	1 (0%)	43	70
1	C	567/583 (97%)	552 (97%)	15 (3%)	0	100	100
1	D	568/583 (97%)	549 (97%)	18 (3%)	1 (0%)	43	70
All	All	2259/2332 (97%)	2188 (97%)	69 (3%)	2 (0%)	48	74

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	337	ALA
1	D	337	ALA

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	422/439 (96%)	411 (97%)	11 (3%)	40	71
1	B	422/439 (96%)	411 (97%)	11 (3%)	40	71
1	C	427/439 (97%)	414 (97%)	13 (3%)	36	67
1	D	428/439 (98%)	415 (97%)	13 (3%)	36	67
All	All	1699/1756 (97%)	1651 (97%)	48 (3%)	38	70

All (48) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	105	ARG
1	A	136	GLU
1	A	205	GLU
1	A	306	CYS
1	A	333	THR
1	A	406	ARG
1	A	419	ASN
1	A	500	GLU
1	A	532	LEU

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Mol	Chain	Res	Type
1	A	535	ASN
1	A	544	VAL
1	B	105	ARG
1	B	203	LYS
1	B	205	GLU
1	B	306	CYS
1	B	331	GLN
1	B	333	THR
1	B	406	ARG
1	B	419	ASN
1	B	500	GLU
1	B	535	ASN
1	B	544	VAL
1	C	19	VAL
1	C	32	THR
1	C	105	ARG
1	C	136	GLU
1	C	205	GLU
1	C	306	CYS
1	C	333	THR
1	C	406	ARG
1	C	419	ASN
1	C	500	GLU
1	C	535	ASN
1	C	544	VAL
1	C	569	LEU
1	D	105	ARG
1	D	136	GLU
1	D	205	GLU
1	D	306	CYS
1	D	331	GLN
1	D	333	THR
1	D	406	ARG
1	D	419	ASN
1	D	500	GLU
1	D	522	GLU
1	D	535	ASN
1	D	544	VAL
1	D	569	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (26) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	21	HIS
1	A	87	ASN
1	A	118	GLN
1	A	283	ASN
1	A	297	GLN
1	A	374	HIS
1	A	382	HIS
1	A	432	GLN
1	B	118	GLN
1	B	259	ASN
1	B	371	HIS
1	B	374	HIS
1	B	432	GLN
1	C	118	GLN
1	C	286	HIS
1	C	294	HIS
1	C	297	GLN
1	C	374	HIS
1	C	432	GLN
1	D	21	HIS
1	D	118	GLN
1	D	259	ASN
1	D	294	HIS
1	D	331	GLN
1	D	374	HIS
1	D	432	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

Of 12 ligands modelled in this entry, 4 are monoatomic - leaving 8 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
3	TPP	D	602	2	26,27,27	1.65	5 (19%)	38,40,40	2.38	11 (28%)
3	TPP	A	602	2	26,27,27	1.52	4 (15%)	38,40,40	2.30	12 (31%)
4	EDO	A	604	-	3,3,3	0.55	0	2,2,2	0.32	0
4	EDO	C	603	-	3,3,3	0.54	0	2,2,2	0.23	0
3	TPP	B	602	2	26,27,27	1.52	3 (11%)	38,40,40	2.47	11 (28%)
3	TPP	C	602	2	26,27,27	1.48	5 (19%)	38,40,40	2.06	7 (18%)
4	EDO	A	603	-	3,3,3	0.65	0	2,2,2	0.16	0
4	EDO	D	603	-	3,3,3	0.54	0	2,2,2	0.28	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
3	TPP	D	602	2	-	1/17/17/17	0/2/2/2
3	TPP	A	602	2	-	1/17/17/17	0/2/2/2
4	EDO	A	604	-	-	1/1/1/1	-
4	EDO	C	603	-	-	0/1/1/1	-
3	TPP	B	602	2	-	3/17/17/17	0/2/2/2
3	TPP	C	602	2	-	2/17/17/17	0/2/2/2
4	EDO	A	603	-	-	0/1/1/1	-
4	EDO	D	603	-	-	1/1/1/1	-

All (17) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	D	602	TPP	C7'-C5'	4.05	1.58	1.51
3	D	602	TPP	C5-C4	4.03	1.43	1.35
3	B	602	TPP	C7'-C5'	3.83	1.58	1.51

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	602	TPP	C5-C4	3.41	1.42	1.35
3	C	602	TPP	C5-C4	3.33	1.42	1.35
3	A	602	TPP	C5-C4	3.28	1.42	1.35
3	C	602	TPP	C7'-C5'	3.27	1.57	1.51
3	A	602	TPP	C7'-C5'	3.18	1.57	1.51
3	C	602	TPP	PA-O3A	-2.73	1.56	1.59
3	B	602	TPP	C4'-N4'	2.72	1.41	1.34
3	A	602	TPP	C2'-N1'	-2.60	1.30	1.34
3	A	602	TPP	C4'-N4'	2.56	1.40	1.34
3	D	602	TPP	C6'-C5'	2.46	1.42	1.37
3	D	602	TPP	PA-O3A	-2.45	1.56	1.59
3	C	602	TPP	C4'-N4'	2.41	1.40	1.34
3	D	602	TPP	C4'-N4'	2.22	1.39	1.34
3	C	602	TPP	C6'-C5'	2.03	1.41	1.37

All (41) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	602	TPP	C2-S1-C5	10.19	97.96	91.22
3	B	602	TPP	C2-S1-C5	10.11	97.91	91.22
3	A	602	TPP	C2-S1-C5	9.31	97.38	91.22
3	C	602	TPP	C2-S1-C5	8.45	96.81	91.22
3	B	602	TPP	C6'-N1'-C2'	4.21	122.98	116.07
3	B	602	TPP	S1-C2-N3	-4.05	107.16	112.30
3	B	602	TPP	CM2-C2'-N1'	4.03	121.50	117.20
3	D	602	TPP	S1-C2-N3	-3.99	107.25	112.30
3	B	602	TPP	N1'-C2'-N3'	-3.98	118.91	125.53
3	A	602	TPP	CM4-C4-C5	-3.89	117.79	127.75
3	B	602	TPP	C4-C5-S1	-3.64	104.88	110.56
3	D	602	TPP	CM2-C2'-N1'	3.60	121.03	117.20
3	C	602	TPP	C5'-C6'-N1'	-3.58	118.01	123.83
3	A	602	TPP	S1-C2-N3	-3.35	108.06	112.30
3	D	602	TPP	C4-C5-S1	-3.34	105.36	110.56
3	C	602	TPP	S1-C2-N3	-3.26	108.17	112.30
3	A	602	TPP	C6'-N1'-C2'	3.22	121.35	116.07
3	D	602	TPP	C6'-N1'-C2'	3.15	121.25	116.07
3	A	602	TPP	C4-C5-S1	-3.01	105.87	110.56
3	C	602	TPP	C4-C5-S1	-2.97	105.93	110.56
3	C	602	TPP	C6'-N1'-C2'	2.89	120.82	116.07
3	A	602	TPP	CM4-C4-N3	2.83	127.09	120.57
3	A	602	TPP	N1'-C2'-N3'	-2.82	120.84	125.53
3	B	602	TPP	C2'-N3'-C4'	2.78	122.37	118.10

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	D	602	TPP	N1'-C2'-N3'	-2.75	120.95	125.53
3	A	602	TPP	C2'-N3'-C4'	2.68	122.22	118.10
3	B	602	TPP	O2A-PA-O3A	2.56	114.19	107.27
3	B	602	TPP	C5'-C6'-N1'	-2.56	119.67	123.83
3	D	602	TPP	O3B-PB-O3A	2.55	113.18	104.64
3	D	602	TPP	CM4-C4-C5	-2.55	121.23	127.75
3	C	602	TPP	O2B-PB-O3A	2.40	112.69	104.64
3	B	602	TPP	CM4-C4-C5	-2.39	121.62	127.75
3	A	602	TPP	N4'-C4'-N3'	2.36	120.22	117.03
3	D	602	TPP	C5'-C6'-N1'	-2.34	120.02	123.83
3	A	602	TPP	CM2-C2'-N1'	2.29	119.64	117.20
3	D	602	TPP	C2'-N3'-C4'	2.27	121.59	118.10
3	A	602	TPP	C5'-C4'-N4'	-2.15	119.25	122.14
3	A	602	TPP	C5'-C6'-N1'	-2.14	120.35	123.83
3	B	602	TPP	C5-C4-N3	2.12	115.53	111.67
3	C	602	TPP	C6'-C5'-C4'	2.06	118.08	115.55
3	D	602	TPP	O3A-PB-O1B	-2.01	100.47	111.04

There are no chirality outliers.

All (9) torsion outliers are listed below:

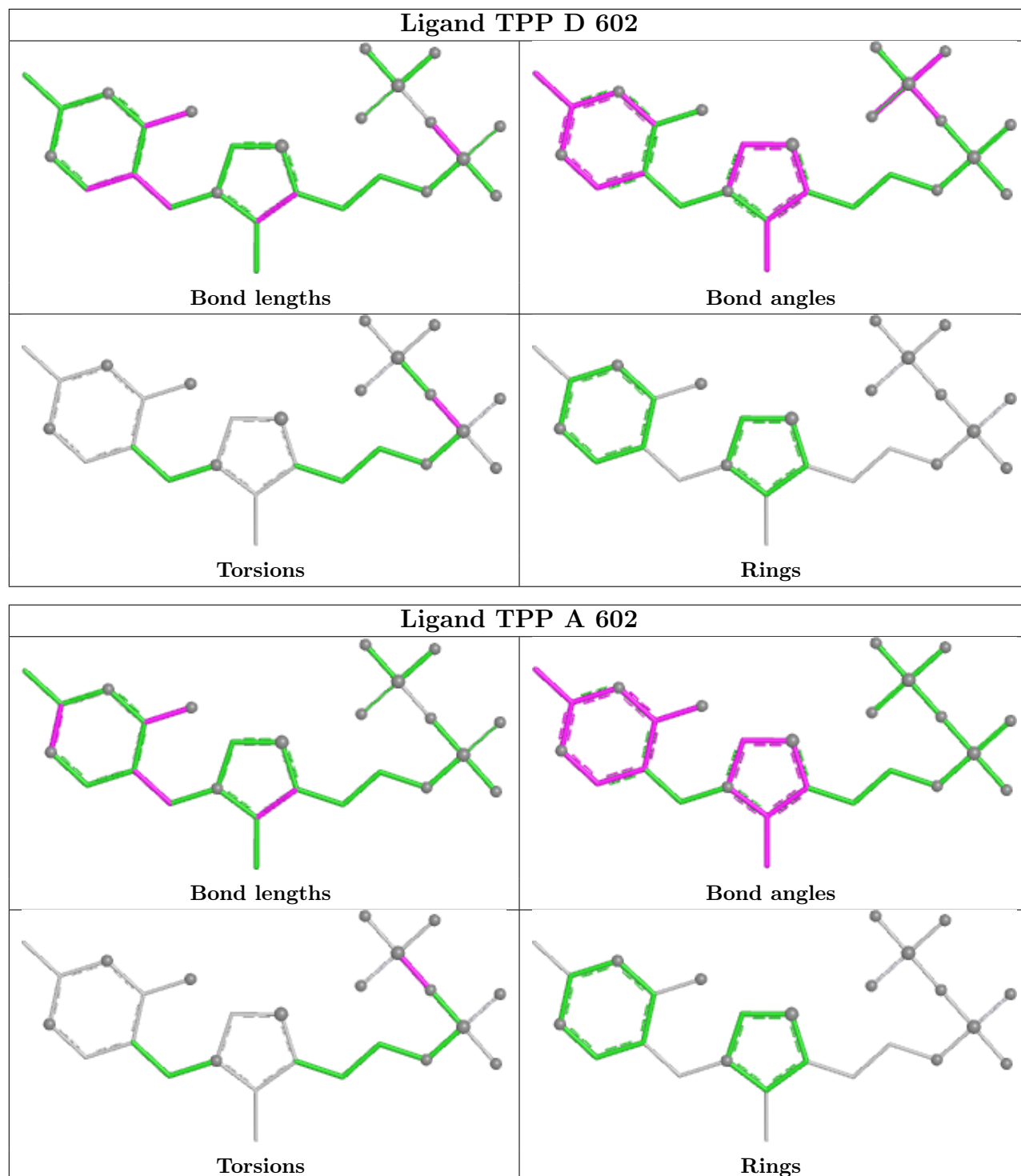
Mol	Chain	Res	Type	Atoms
3	B	602	TPP	PA-O3A-PB-O3B
4	D	603	EDO	O1-C1-C2-O2
3	C	602	TPP	PB-O3A-PA-O7
3	D	602	TPP	PB-O3A-PA-O7
3	B	602	TPP	PA-O3A-PB-O2B
3	C	602	TPP	PA-O3A-PB-O1B
4	A	604	EDO	O1-C1-C2-O2
3	A	602	TPP	PA-O3A-PB-O2B
3	B	602	TPP	PA-O3A-PB-O1B

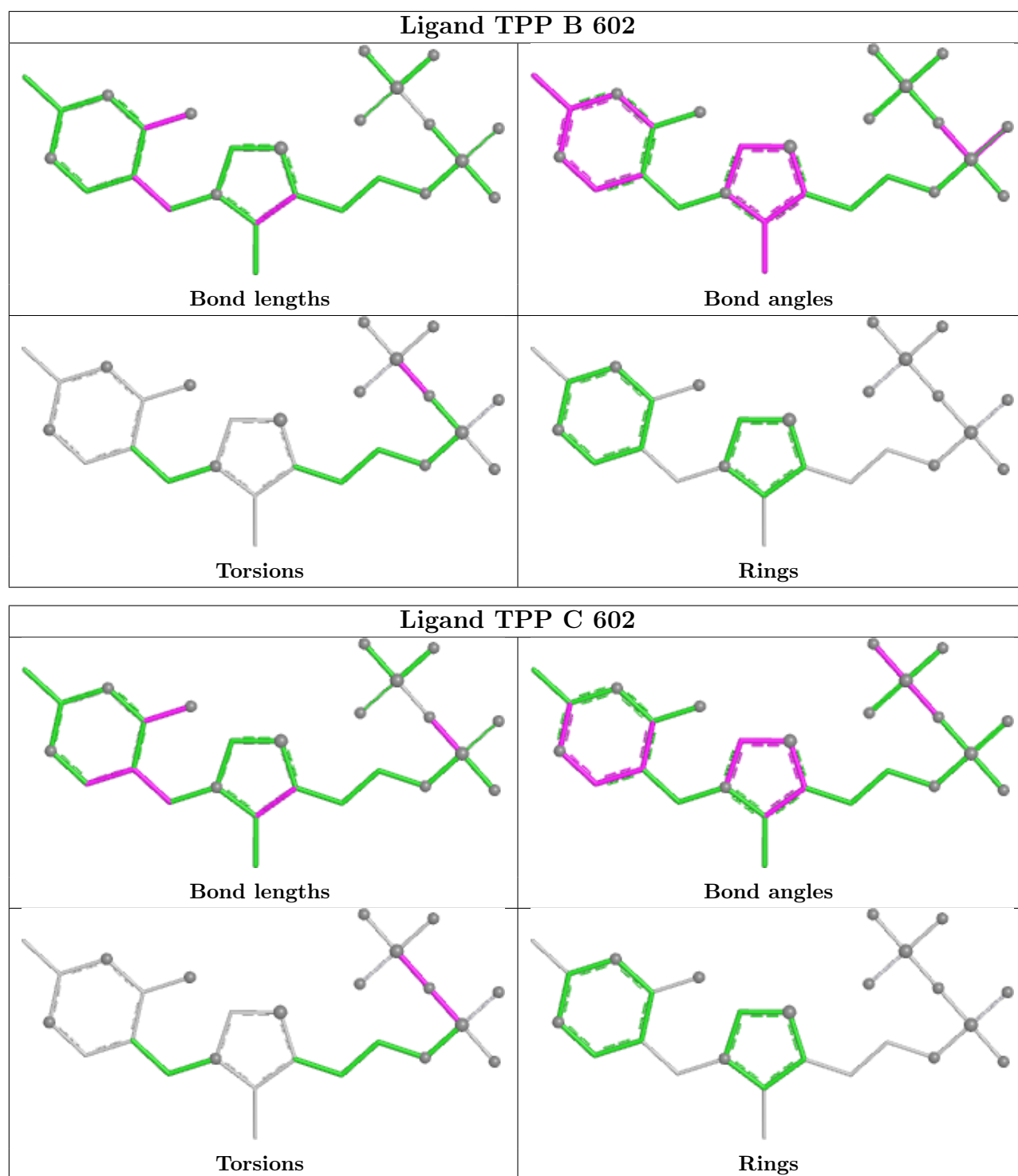
There are no ring outliers.

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 ⓘ

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	563/583 (96%)	-0.52	3 (0%) 87 83	20, 49, 73, 114	1 (0%)
1	B	563/583 (96%)	-0.44	3 (0%) 87 83	22, 57, 81, 130	1 (0%)
1	C	569/583 (97%)	-0.58	4 (0%) 84 80	31, 46, 66, 136	0
1	D	569/583 (97%)	-0.42	4 (0%) 84 80	20, 55, 82, 130	1 (0%)
All	All	2264/2332 (97%)	-0.49	14 (0%) 85 81	20, 51, 78, 136	3 (0%)

All (14) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	564	GLY	3.7
1	C	570	TYR	3.5
1	B	181	VAL	3.3
1	D	570	TYR	2.9
1	D	566	THR	2.7
1	B	557	ILE	2.5
1	C	336	ASP	2.3
1	D	565	SER	2.2
1	C	565	SER	2.2
1	D	569	LEU	2.1
1	A	559	MET	2.0
1	A	564	GLY	2.0
1	A	337	ALA	2.0
1	B	564	GLY	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 ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands ⓘ

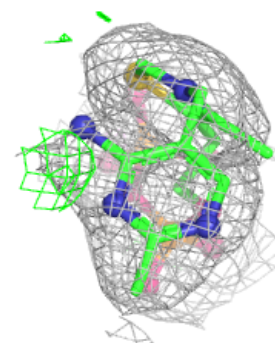
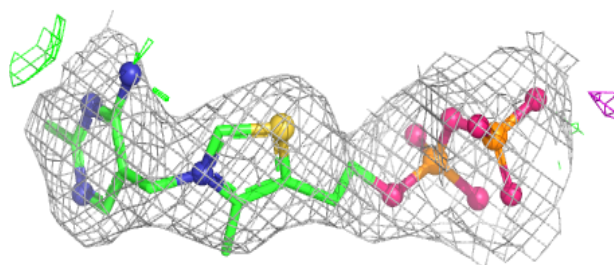
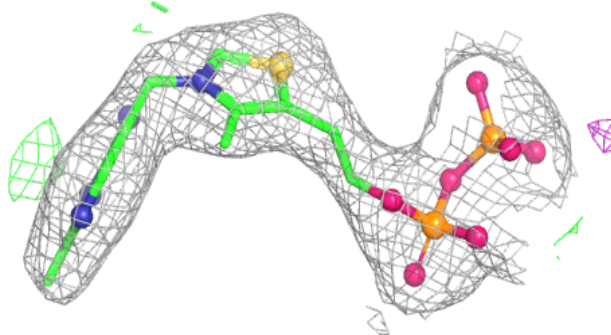
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	EDO	A	604	4/4	0.72	0.23	73,77,80,81	0
4	EDO	C	603	4/4	0.80	0.15	75,75,86,87	0
4	EDO	A	603	4/4	0.86	0.15	52,64,66,69	0
4	EDO	D	603	4/4	0.88	0.13	62,62,67,69	0
2	MG	B	601	1/1	0.97	0.04	34,34,34,34	0
3	TPP	B	602	26/26	0.98	0.06	43,48,59,60	0
3	TPP	D	602	26/26	0.98	0.06	40,52,54,57	0
3	TPP	A	602	26/26	0.98	0.06	40,47,52,54	0
3	TPP	C	602	26/26	0.99	0.04	35,48,52,55	0
2	MG	D	601	1/1	1.00	0.02	37,37,37,37	0
2	MG	A	601	1/1	1.00	0.01	39,39,39,39	0
2	MG	C	601	1/1	1.00	0.01	33,33,33,33	0

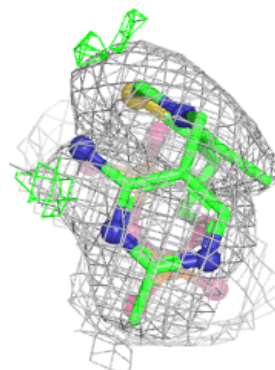
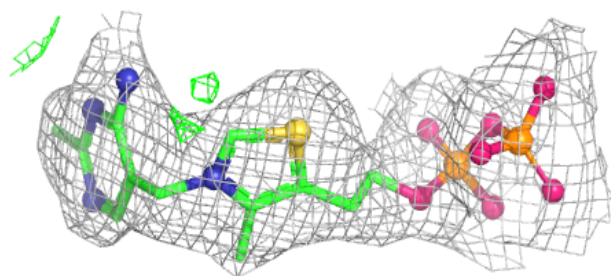
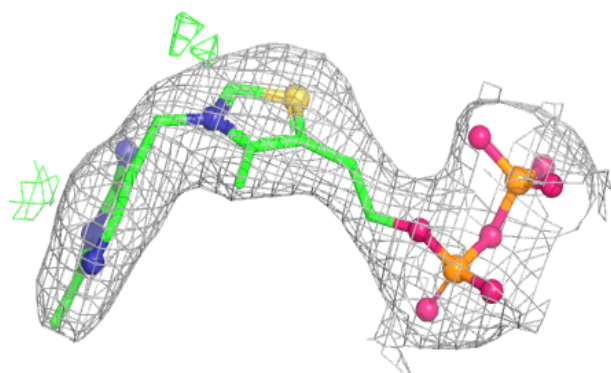
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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

Electron density around TPP B 602:

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

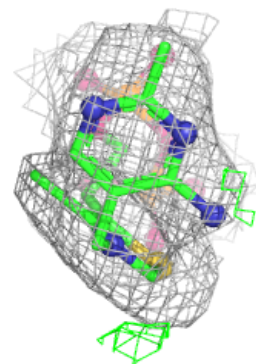
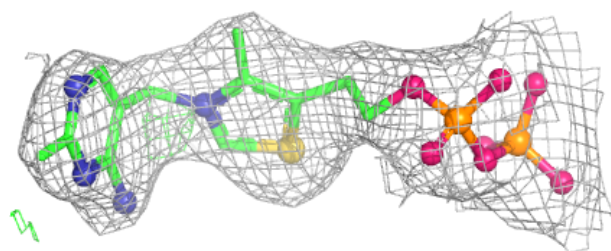
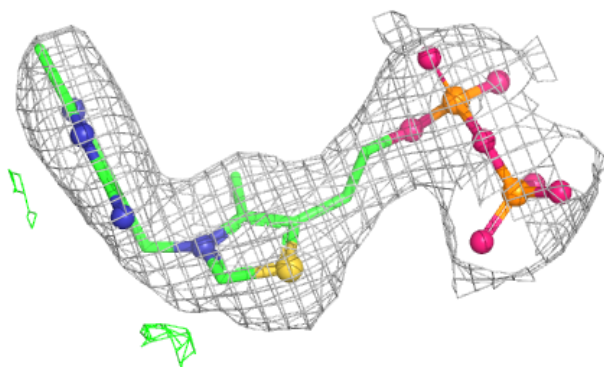
**Electron density around TPP D 602:**

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

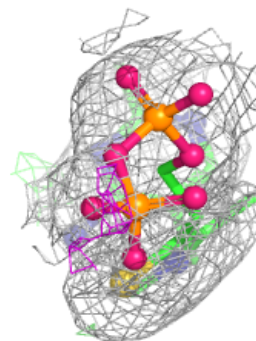
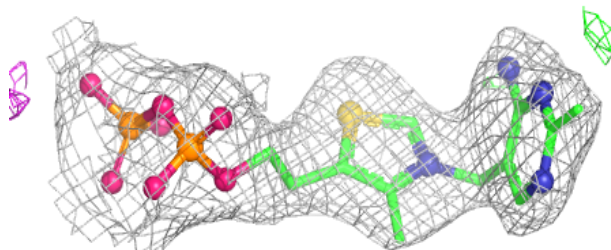
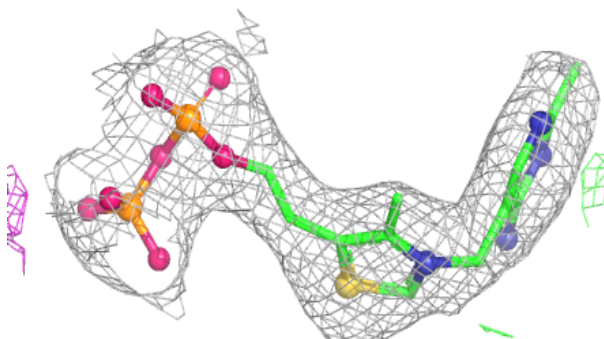


Electron density around TPP A 602:

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

**Electron density around TPP C 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.