wwPDB X-ray Structure Validation Summary Report (i)

Aug 19, 2023 – 10:25 PM EDT

PDB ID	:	2H1H
Title	:	E. coli heptosyltransferase WaaC with ADP-2-deoxy-2-fluoro heptose
Authors	:	Grizot, S.; Salem, M.; Vongsouthi, V.; Durand, L.; Moreau, F.; Dohi, H.; Vincent, S.; Escaich, S.; Ducruix, A.
Deposited on	:	2006-05-16
Resolution	:	2.40 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 (i) 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 (i)) were used in the production of this report:

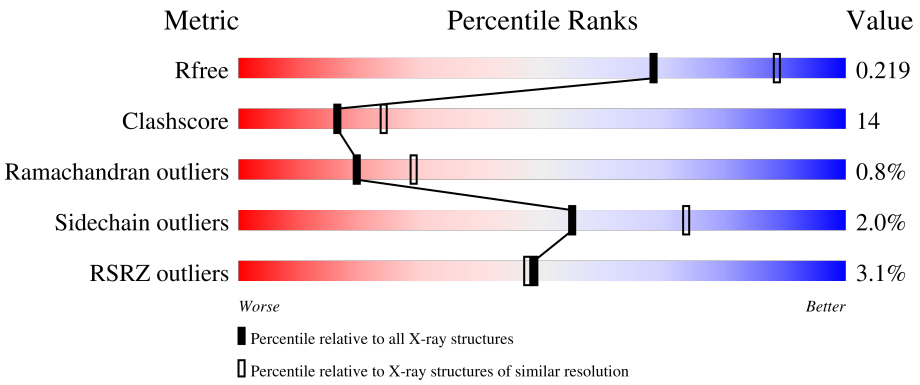
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 Å.

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



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (2.40-2.40)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=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	334	3% 72% 24% • •
1	B	334	3% 62% 31% • 6%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 5143 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 Lipopolysaccharide heptosyltransferase 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	322	2533	1616	458	453	6	0	0	0
1	B	315	2487	1587	450	444	6	0	0	0

There are 70 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	85	LYS	GLU	SEE REMARK 999	UNP P24173
A	301	GLY	-	cloning artifact	UNP P24173
A	302	ASN	-	cloning artifact	UNP P24173
A	303	GLU	-	cloning artifact	UNP P24173
A	304	LEU	-	cloning artifact	UNP P24173
A	305	SER	-	cloning artifact	UNP P24173
A	306	GLN	-	cloning artifact	UNP P24173
A	307	LEU	-	cloning artifact	UNP P24173
A	308	THR	-	cloning artifact	UNP P24173
A	309	ALA	-	cloning artifact	UNP P24173
A	310	ASN	-	cloning artifact	UNP P24173
A	311	ALA	-	cloning artifact	UNP P24173
A	312	VAL	-	cloning artifact	UNP P24173
A	313	LYS	-	cloning artifact	UNP P24173
A	314	GLN	-	cloning artifact	UNP P24173
A	315	PHE	-	cloning artifact	UNP P24173
A	316	ILE	-	cloning artifact	UNP P24173
A	317	GLU	-	cloning artifact	UNP P24173
A	318	GLU	-	cloning artifact	UNP P24173
A	319	ASN	-	cloning artifact	UNP P24173
A	320	ALA	-	cloning artifact	UNP P24173
A	321	GLU	-	cloning artifact	UNP P24173
A	322	LYS	-	cloning artifact	UNP P24173
A	323	ALA	-	cloning artifact	UNP P24173
A	324	ALA	-	cloning artifact	UNP P24173

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Chain	Residue	Modelled	Actual	Comment	Reference
A	325	MET	-	cloning artifact	UNP P24173
A	326	ILE	-	cloning artifact	UNP P24173
A	327	LEU	-	cloning artifact	UNP P24173
A	328	GLU	-	cloning artifact	UNP P24173
A	329	HIS	-	expression tag	UNP P24173
A	330	HIS	-	expression tag	UNP P24173
A	331	HIS	-	expression tag	UNP P24173
A	332	HIS	-	expression tag	UNP P24173
A	333	HIS	-	expression tag	UNP P24173
A	334	HIS	-	expression tag	UNP P24173
B	85	LYS	GLU	SEE REMARK 999	UNP P24173
B	301	GLY	-	cloning artifact	UNP P24173
B	302	ASN	-	cloning artifact	UNP P24173
B	303	GLU	-	cloning artifact	UNP P24173
B	304	LEU	-	cloning artifact	UNP P24173
B	305	SER	-	cloning artifact	UNP P24173
B	306	GLN	-	cloning artifact	UNP P24173
B	307	LEU	-	cloning artifact	UNP P24173
B	308	THR	-	cloning artifact	UNP P24173
B	309	ALA	-	cloning artifact	UNP P24173
B	310	ASN	-	cloning artifact	UNP P24173
B	311	ALA	-	cloning artifact	UNP P24173
B	312	VAL	-	cloning artifact	UNP P24173
B	313	LYS	-	cloning artifact	UNP P24173
B	314	GLN	-	cloning artifact	UNP P24173
B	315	PHE	-	cloning artifact	UNP P24173
B	316	ILE	-	cloning artifact	UNP P24173
B	317	GLU	-	cloning artifact	UNP P24173
B	318	GLU	-	cloning artifact	UNP P24173
B	319	ASN	-	cloning artifact	UNP P24173
B	320	ALA	-	cloning artifact	UNP P24173
B	321	GLU	-	cloning artifact	UNP P24173
B	322	LYS	-	cloning artifact	UNP P24173
B	323	ALA	-	cloning artifact	UNP P24173
B	324	ALA	-	cloning artifact	UNP P24173
B	325	MET	-	cloning artifact	UNP P24173
B	326	ILE	-	cloning artifact	UNP P24173
A	327	LEU	-	cloning artifact	UNP P24173
A	328	GLU	-	cloning artifact	UNP P24173
A	329	HIS	-	expression tag	UNP P24173
A	330	HIS	-	expression tag	UNP P24173
A	331	HIS	-	expression tag	UNP P24173

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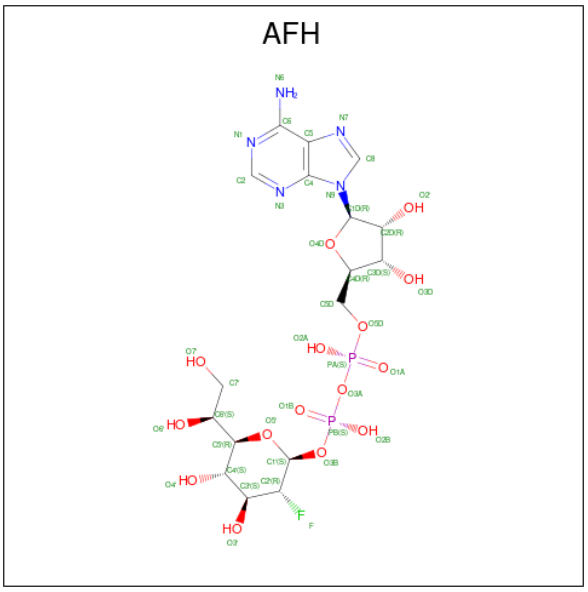
Chain	Residue	Modelled	Actual	Comment	Reference
A	332	HIS	-	expression tag	UNP P24173
A	333	HIS	-	expression tag	UNP P24173
A	334	HIS	-	expression tag	UNP P24173

- Molecule 2 is ADENOSINE-5'-DIPHOSPHATE-2-DEOXY-2-FLUORO HEPTOSE (three-letter code: AFH) (formula: $C_{17}H_{26}FN_5O_{15}P_2$).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
			Total	C	F	N	O	P		
2	A	1	40	17	1	5	15	2	0	0
			Total	C	F	N	O	P		
2	B	1	40	17	1	5	15	2	0	0

- Molecule 3 is water.

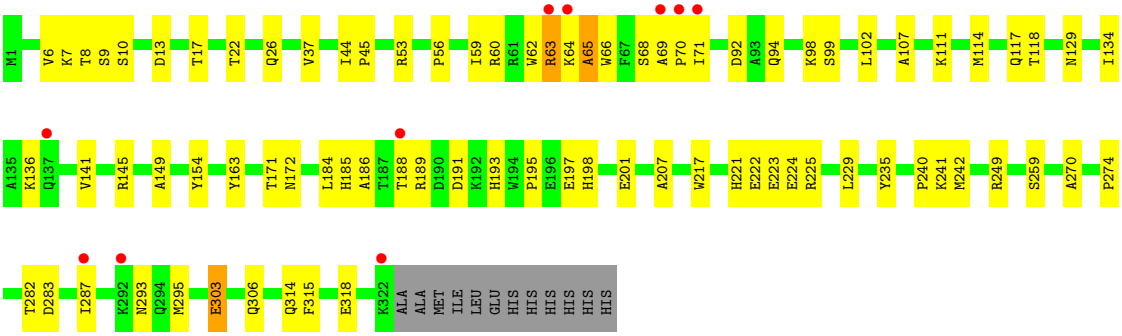
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	26	26	26	0	0
			Total	O		
3	B	17	17	17	0	0

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.

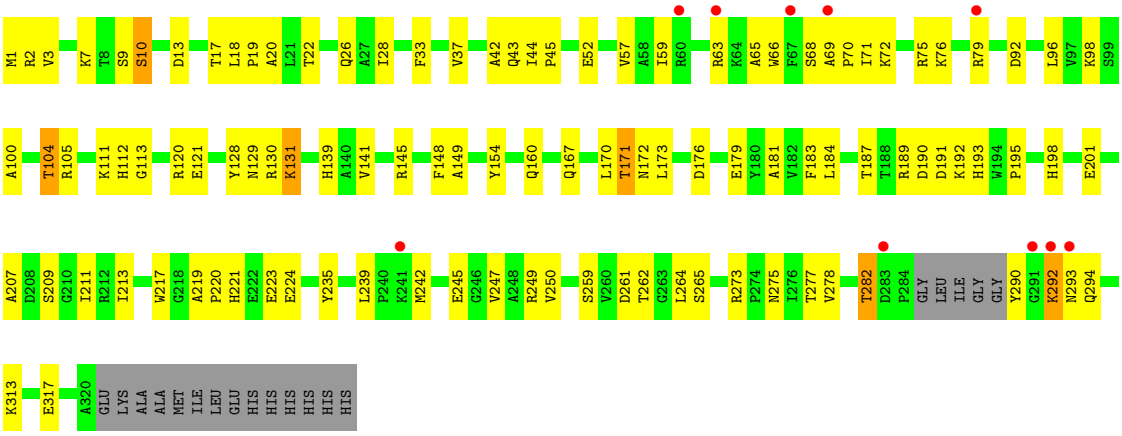
- Molecule 1: Lipopolysaccharide heptosyltransferase 1

Chain A:



- Molecule 1: Lipopolysaccharide heptosyltransferase 1

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	77.53Å 88.90Å 90.80Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.40 19.65 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.8 (20.00-2.40) 99.8 (19.65-2.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.11	Depositor
$< I/\sigma(I) >$ [1]	2.57 (at 2.41Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.222 , 0.269 0.212 , 0.219	Depositor DCC
R_{free} test set	1233 reflections (4.92%)	wwPDB-VP
Wilson B-factor (Å^2)	32.4	Xtriage
Anisotropy	0.053	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 36.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.000 for -h,l,k	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	5143	wwPDB-VP
Average B, all atoms (Å^2)	31.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 24.06 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 4.1232e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: AFH

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	0.37	0/2596	0.63	0/3523
1	B	0.35	0/2549	0.63	0/3460
All	All	0.36	0/5145	0.63	0/6983

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	2533	0	2538	60	0
1	B	2487	0	2487	87	0
2	A	40	0	24	2	0
2	B	40	0	24	0	0
3	A	26	0	0	0	0
3	B	17	0	0	0	0
All	All	5143	0	5073	146	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 14.

The worst 5 of 146 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:172:ASN:HD22	1:B:249:ARG:HE	1.00	0.99
1:A:111:LYS:H	1:A:129:ASN:HD22	1.00	0.92
1:B:111:LYS:H	1:B:129:ASN:HD22	1.09	0.90
1:A:188:THR:HB	2:A:400:AFH:O1A	1.75	0.86
1:B:68:SER:O	1:B:72:LYS:HB2	1.75	0.85

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	320/334 (96%)	303 (95%)	14 (4%)	3 (1%)	17 25
1	B	311/334 (93%)	292 (94%)	17 (6%)	2 (1%)	25 36
All	All	631/668 (94%)	595 (94%)	31 (5%)	5 (1%)	19 29

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	65	ALA
1	A	63	ARG
1	B	292	LYS
1	B	10	SER
1	A	59	ILE

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	258/268 (96%)	255 (99%)	3 (1%)	71	85
1	B	254/268 (95%)	247 (97%)	7 (3%)	43	63
All	All	512/536 (96%)	502 (98%)	10 (2%)	55	74

5 of 10 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	171	THR
1	B	264	LEU
1	B	282	THR
1	B	76	LYS
1	B	104	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 17 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	275	ASN
1	B	302	ASN
1	B	25	GLN
1	B	83	GLN
1	B	129	ASN

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 monosaccharides in this entry.

5.6 Ligand geometry (i)

2 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	AFH	B	400	-	37,43,43	1.77	10 (27%)	45,66,66	1.77	7 (15%)
2	AFH	A	400	-	37,43,43	1.75	11 (29%)	45,66,66	1.77	7 (15%)

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
2	AFH	B	400	-	-	11/22/63/63	0/4/4/4
2	AFH	A	400	-	-	7/22/63/63	0/4/4/4

The worst 5 of 21 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	400	AFH	C2-N3	4.80	1.39	1.32
2	A	400	AFH	C2-N3	4.44	1.39	1.32
2	B	400	AFH	O5'-C5'	3.97	1.50	1.44
2	B	400	AFH	C4-N3	3.72	1.40	1.35
2	A	400	AFH	O5'-C5'	3.57	1.49	1.44

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	A	400	AFH	N3-C2-N1	-7.00	117.74	128.68
2	B	400	AFH	N3-C2-N1	-6.80	118.05	128.68
2	A	400	AFH	O5'-C1'-O3B	-4.34	105.69	111.36
2	B	400	AFH	O5'-C1'-O3B	-4.31	105.73	111.36
2	B	400	AFH	O3B-C1'-C2'	3.16	114.17	108.38

There are no chirality outliers.

5 of 18 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	400	AFH	PA-O3A-PB-O3B
2	A	400	AFH	C5'-C6'-C7'-O7'
2	A	400	AFH	O6'-C6'-C7'-O7'
2	B	400	AFH	PA-O3A-PB-O3B
2	B	400	AFH	C5'-C6'-C7'-O7'

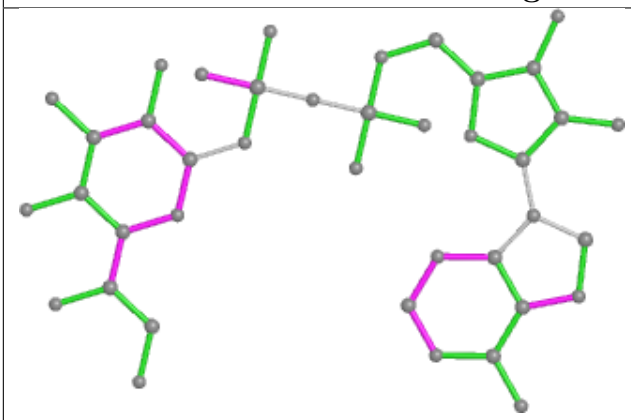
There are no ring outliers.

1 monomer is involved in 2 short contacts:

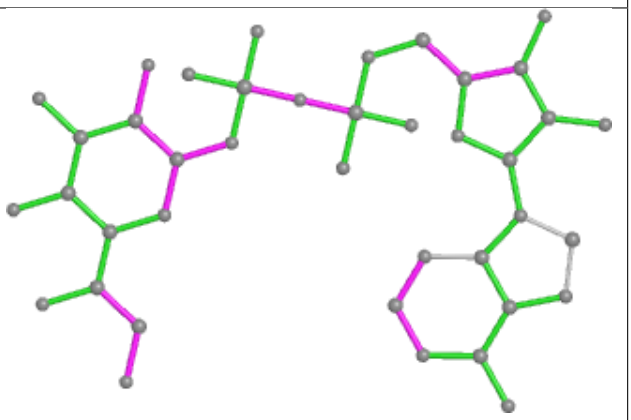
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	400	AFH	2	0

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 then 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.

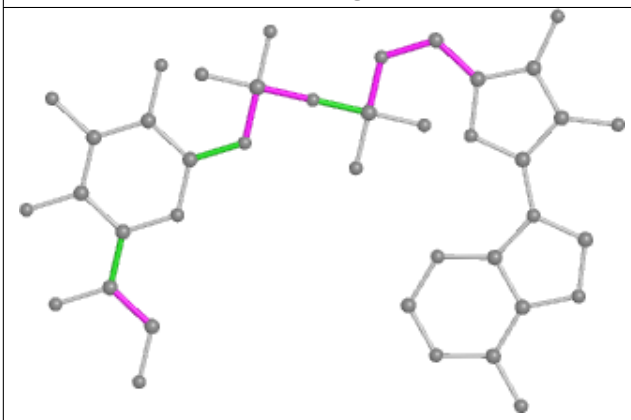
Ligand AFH B 400



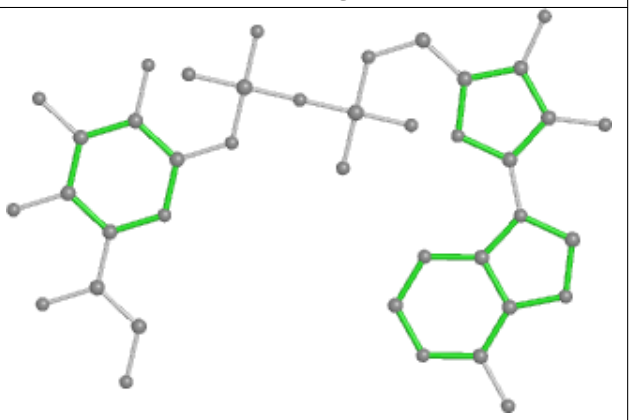
Bond lengths



Bond angles

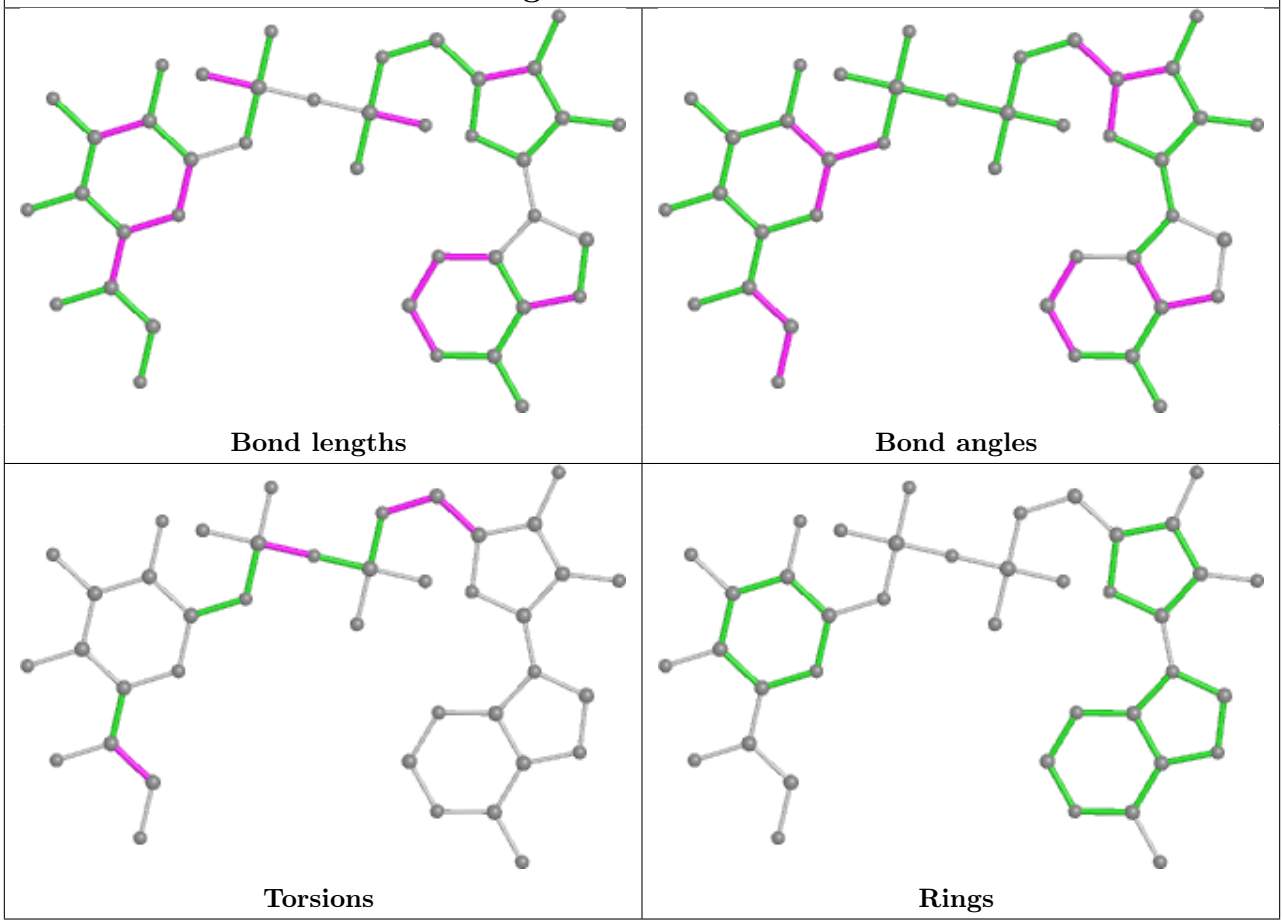


Torsions



Rings

Ligand AFH A 400



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	322/334 (96%)	0.00	10 (3%)	49	47	14, 27, 47, 68	0
1	B	315/334 (94%)	0.11	10 (3%)	47	46	15, 30, 55, 66	0
All	All	637/668 (95%)	0.06	20 (3%)	49	47	14, 28, 53, 68	0

The worst 5 of 20 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	292	LYS	5.3
1	A	188	THR	4.3
1	A	70	PRO	3.7
1	A	63	ARG	3.6
1	A	69	ALA	3.6

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 monosaccharides in this entry.

6.4 Ligands (i)

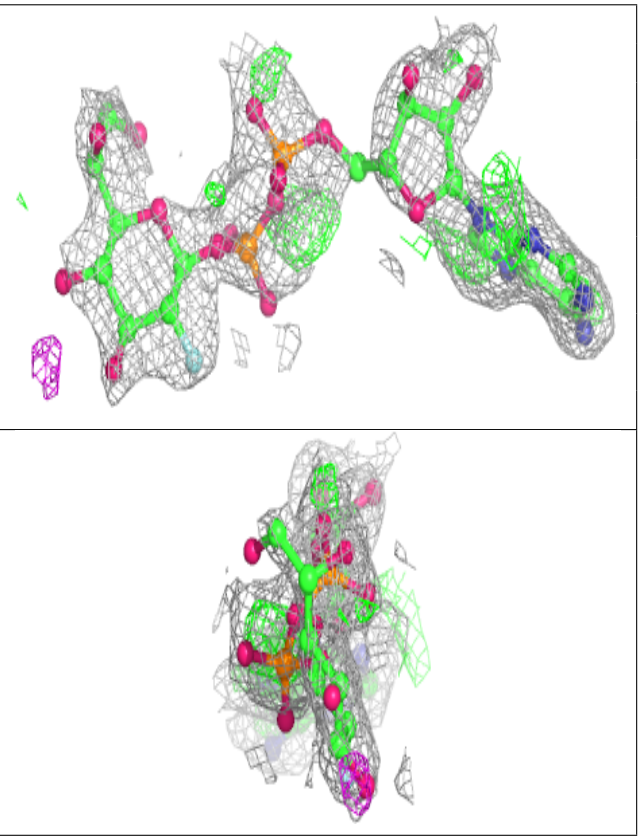
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	AFH	A	400	40/40	0.75	0.31	26,34,39,40	40
2	AFH	B	400	40/40	0.93	0.18	36,45,48,48	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.

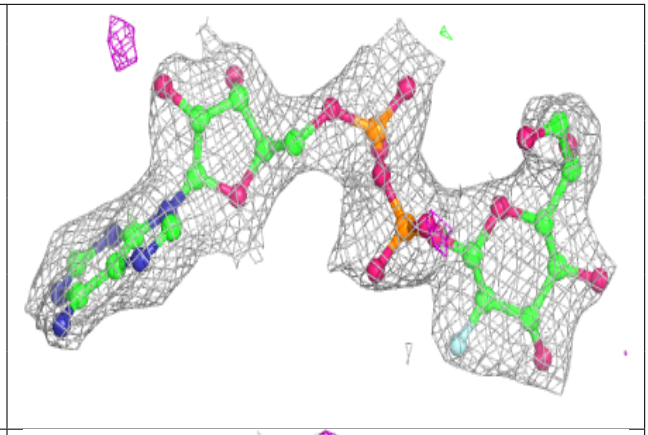
Electron density around AFH A 400:

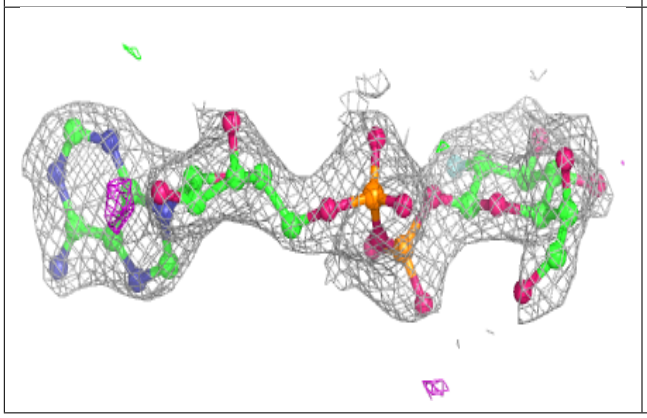
2mF$_o$-DF$_c$ (at 0.7 rmsd) in gray
mF$_o$-DF$_c$ (at 3 rmsd) in purple (negative) and green (positive)

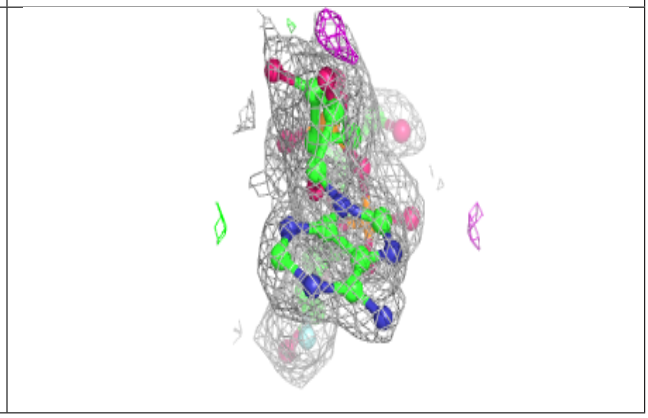


Electron density around AFH B 400:

$2mF_o$-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.