



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 05:12 AM UTC

PDB ID : 3SLO / pdb_00003slo
Title : Pre-cleavage Structure of the Autotransporter EspP - N1023D mutant
Authors : Barnard, T.B.; Noinaj, N.; Easley, N.C.; Kuszak, A.J.; Buchanan, S.K.
Deposited on : 2011-06-24
Resolution : 2.52 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

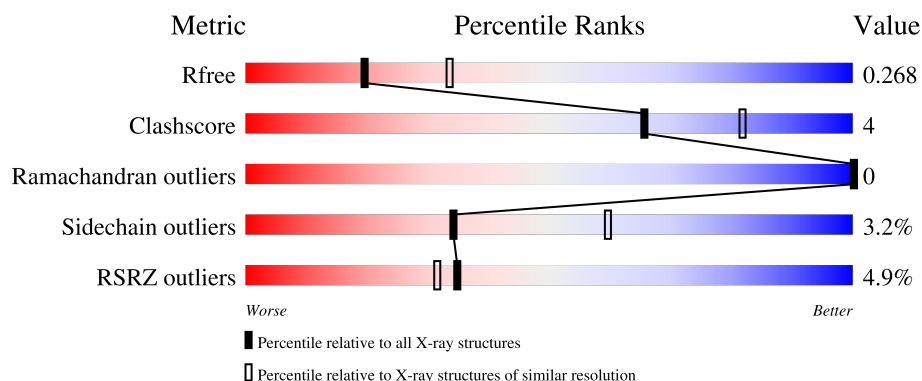
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.52 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	7383 (2.54-2.50)
Clashscore	190562	8079 (2.54-2.50)
Ramachandran outliers	187476	7944 (2.54-2.50)
Sidechain outliers	187428	7946 (2.54-2.50)
RSRZ outliers	180081	7387 (2.54-2.50)

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	313	5% 89% 7%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2468 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.

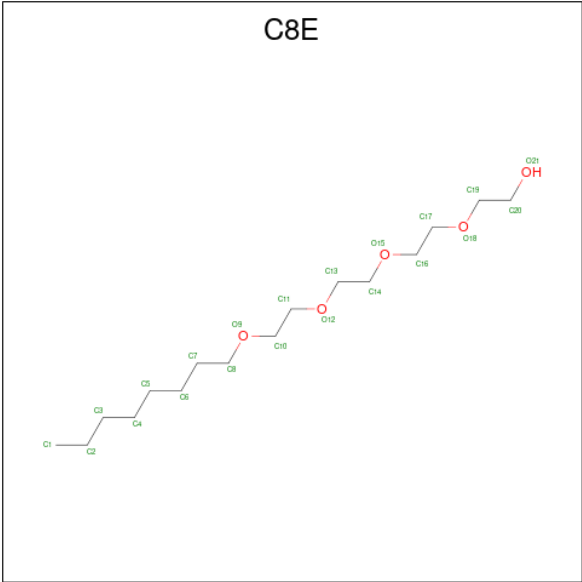
- Molecule 1 is a protein called Serine protease espP.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	306	Total	C	N	O	S	0	0	0
			2307	1453	397	450	7			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	988	ALA	-	expression tag	UNP Q7BSW5
A	989	PRO	-	expression tag	UNP Q7BSW5
A	990	LYS	-	expression tag	UNP Q7BSW5
A	991	ASP	-	expression tag	UNP Q7BSW5
A	992	ASN	-	expression tag	UNP Q7BSW5
A	993	HIS	-	expression tag	UNP Q7BSW5
A	994	HIS	-	expression tag	UNP Q7BSW5
A	995	HIS	-	expression tag	UNP Q7BSW5
A	996	HIS	-	expression tag	UNP Q7BSW5
A	997	HIS	-	expression tag	UNP Q7BSW5
A	998	HIS	-	expression tag	UNP Q7BSW5
A	1023	ASP	ASN	engineered mutation	UNP Q7BSW5

- Molecule 2 is (HYDROXYETHYLOXY)TRI(ETHYLOXY)OCTANE (CCD ID: C8E) (formula: C₁₆H₃₄O₅).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			9	6	3		
2	A	1	Total	C	O	0	0
			19	15	4		
2	A	1	Total	C	O	0	0
			12	10	2		
2	A	1	Total	C	O	0	0
			12	10	2		
2	A	1	Total	C	O	0	0
			17	14	3		
2	A	1	Total	C	O	0	0
			15	12	3		
2	A	1	Total	C	O	0	0
			13	11	2		
2	A	1	Total	C	O	0	0
			14	12	2		

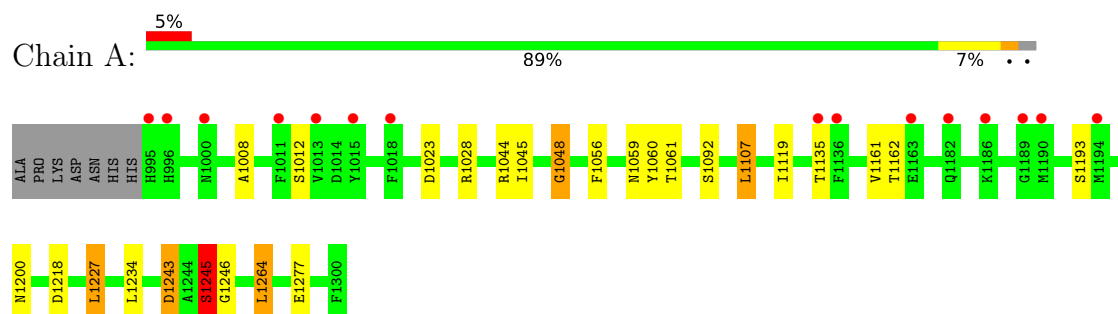
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	50	Total	O	0	0
			50	50		

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: Serine protease espP



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	31.14Å 121.66Å 123.00Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.42 – 2.52 30.42 – 2.52	Depositor EDS
% Data completeness (in resolution range)	98.7 (30.42-2.52) 98.6 (30.42-2.52)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.70 (at 2.51Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.208 , 0.258 (Not available) , 0.268	Depositor DCC
R_{free} test set	840 reflections (5.12%)	wwPDB-VP
Wilson B-factor (Å ²)	48.9	Xtriage
Anisotropy	0.692	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 48.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.009 for -h,l,k	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	2468	wwPDB-VP
Average B, all atoms (Å ²)	69.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.66% 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: C8E

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	1.12	0/2358	1.04	5/3185 (0.2%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1246	GLY	N-CA-C	5.85	118.48	110.69
1	A	1277	GLU	N-CA-C	5.79	118.20	109.23
1	A	1245	SER	N-CA-C	5.38	117.14	111.28
1	A	1048	GLY	N-CA-C	5.33	118.49	110.18
1	A	1135	THR	N-CA-C	-5.32	104.27	111.55

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	2307	0	2111	18	0
2	A	111	0	170	3	0
3	A	50	0	0	1	0
All	All	2468	0	2281	18	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including

hydrogen atoms). The all-atom clashscore for this structure is 4.

All (18) 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:1264:LEU:C	1:A:1264:LEU:HD12	2.08	0.79
1:A:1023:ASP:OD2	1:A:1028:ARG:HD3	1.99	0.62
1:A:1264:LEU:HD12	1:A:1264:LEU:O	1.99	0.62
1:A:1061:THR:HG21	2:A:1:C8E:H102	1.83	0.60
1:A:1161:VAL:HG12	1:A:1162:THR:HG23	1.88	0.54
1:A:1264:LEU:C	1:A:1264:LEU:CD1	2.79	0.54
1:A:1048:GLY:O	1:A:1059:ASN:HA	2.08	0.53
1:A:1044:ARG:HG2	1:A:1045:ILE:N	2.24	0.52
1:A:1008:ALA:HB3	3:A:42:HOH:O	2.07	0.52
1:A:1107:LEU:HD23	1:A:1107:LEU:N	2.27	0.49
1:A:1060:TYR:N	1:A:1060:TYR:CD1	2.80	0.48
1:A:1056:PHE:HA	1:A:1092:SER:O	2.14	0.47
1:A:1227:LEU:HD23	2:A:1302:C8E:H21	1.98	0.45
1:A:1107:LEU:HD23	1:A:1107:LEU:H	1.82	0.45
1:A:1218:ASP:OD1	1:A:1218:ASP:N	2.50	0.44
1:A:1119:ILE:HD11	2:A:1304:C8E:C7	2.49	0.43
1:A:1243:ASP:OD2	1:A:1245:SER:OG	2.37	0.42
1:A:1200:ASN:O	1:A:1234:LEU:HD23	2.22	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	304/313 (97%)	294 (97%)	10 (3%)	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	217/246 (88%)	210 (97%)	7 (3%)	34 60

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1012	SER
1	A	1107	LEU
1	A	1193	SER
1	A	1227	LEU
1	A	1243	ASP
1	A	1245	SER
1	A	1264	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1026	ASN
1	A	1290	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 oligosaccharides in this entry.

5.6 Ligand geometry

8 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	C8E	A	1306	-	12,12,20	0.59	0	11,11,19	0.61	0
2	C8E	A	1304	-	16,16,20	0.57	0	15,15,19	0.75	0
2	C8E	A	1301	-	18,18,20	0.60	0	17,17,19	0.63	0
2	C8E	A	1307	-	13,13,20	0.63	0	12,12,19	0.50	0
2	C8E	A	1303	-	11,11,20	0.65	0	10,10,19	0.39	0
2	C8E	A	1302	-	11,11,20	0.68	0	10,10,19	0.59	0
2	C8E	A	1	-	8,8,20	0.62	0	7,7,19	0.42	0
2	C8E	A	1305	-	14,14,20	0.74	0	13,13,19	0.72	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
2	C8E	A	1306	-	-	5/10/10/18	-
2	C8E	A	1304	-	-	8/14/14/18	-
2	C8E	A	1301	-	-	7/16/16/18	-
2	C8E	A	1307	-	-	6/11/11/18	-
2	C8E	A	1303	-	-	3/9/9/18	-
2	C8E	A	1302	-	-	0/9/9/18	-
2	C8E	A	1	-	-	4/6/6/18	-
2	C8E	A	1305	-	-	5/12/12/18	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (38) torsion outliers are listed below:

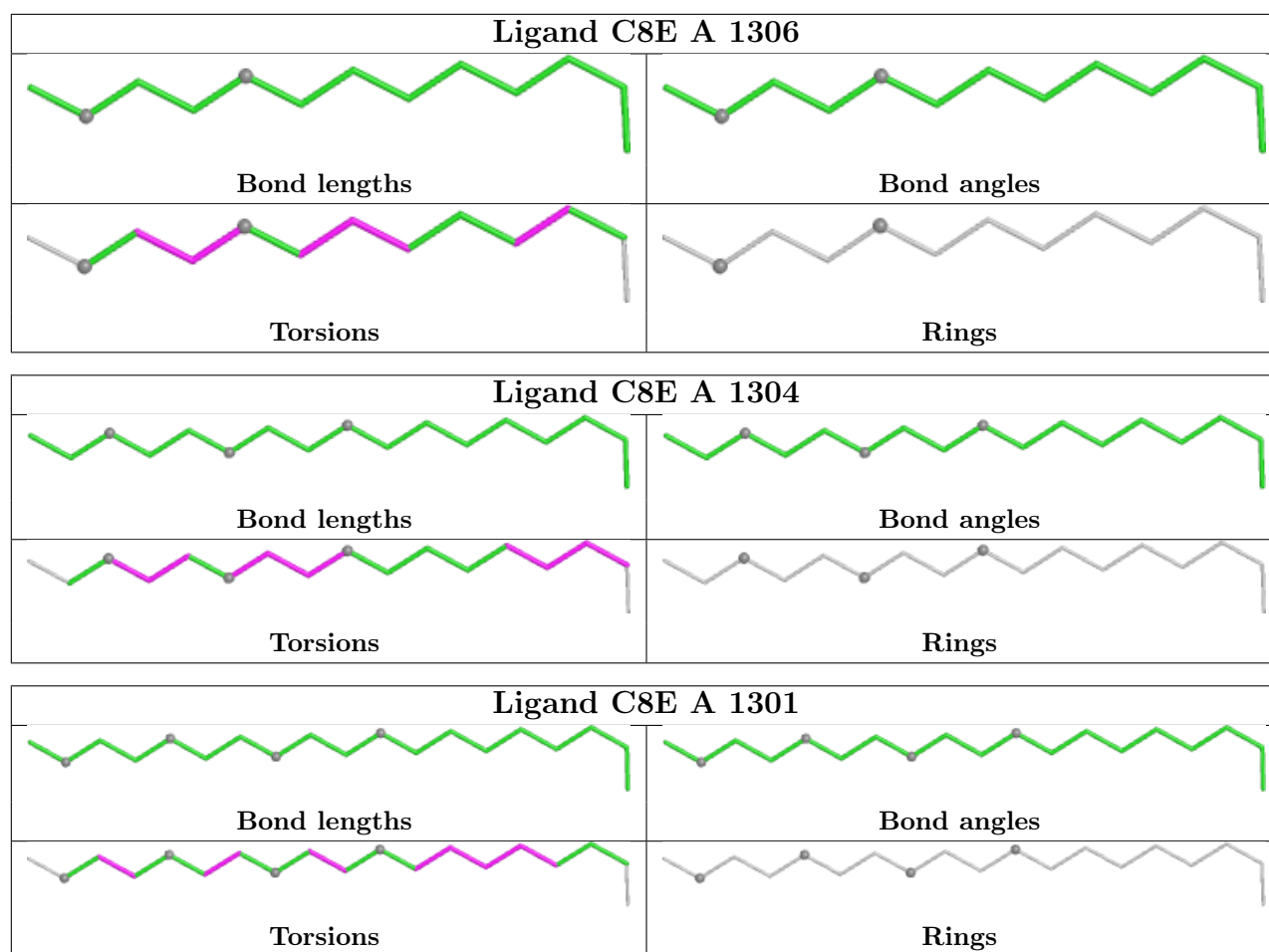
Mol	Chain	Res	Type	Atoms
2	A	1304	C8E	C13-C14-O15-C16
2	A	1306	C8E	O9-C10-C11-O12
2	A	1307	C8E	O9-C10-C11-O12
2	A	1304	C8E	C10-C11-O12-C13
2	A	1305	C8E	C6-C7-C8-O9
2	A	1305	C8E	O9-C10-C11-O12
2	A	1301	C8E	C6-C7-C8-O9
2	A	1303	C8E	O9-C10-C11-O12
2	A	1	C8E	O12-C13-C14-O15
2	A	1301	C8E	O12-C13-C14-O15
2	A	1	C8E	O9-C10-C11-O12
2	A	1303	C8E	C6-C7-C8-O9
2	A	1301	C8E	C4-C5-C6-C7
2	A	1307	C8E	C4-C5-C6-C7
2	A	1301	C8E	C3-C4-C5-C6
2	A	1301	C8E	C5-C6-C7-C8
2	A	1305	C8E	C4-C5-C6-C7
2	A	1301	C8E	O15-C16-C17-O18
2	A	1307	C8E	C14-C13-O12-C11
2	A	1307	C8E	C3-C4-C5-C6
2	A	1	C8E	C13-C14-O15-C16
2	A	1306	C8E	C11-C10-O9-C8
2	A	1305	C8E	O12-C13-C14-O15
2	A	1303	C8E	C2-C3-C4-C5
2	A	1304	C8E	C1-C2-C3-C4
2	A	1304	C8E	O9-C10-C11-O12
2	A	1304	C8E	C2-C3-C4-C5
2	A	1306	C8E	C5-C6-C7-C8
2	A	1	C8E	C10-C11-O12-C13
2	A	1306	C8E	C2-C3-C4-C5
2	A	1307	C8E	C1-C2-C3-C4
2	A	1307	C8E	C10-C11-O12-C13
2	A	1304	C8E	O12-C13-C14-O15
2	A	1304	C8E	C3-C4-C5-C6
2	A	1304	C8E	C11-C10-O9-C8
2	A	1301	C8E	O9-C10-C11-O12
2	A	1306	C8E	C6-C7-C8-O9
2	A	1305	C8E	C5-C6-C7-C8

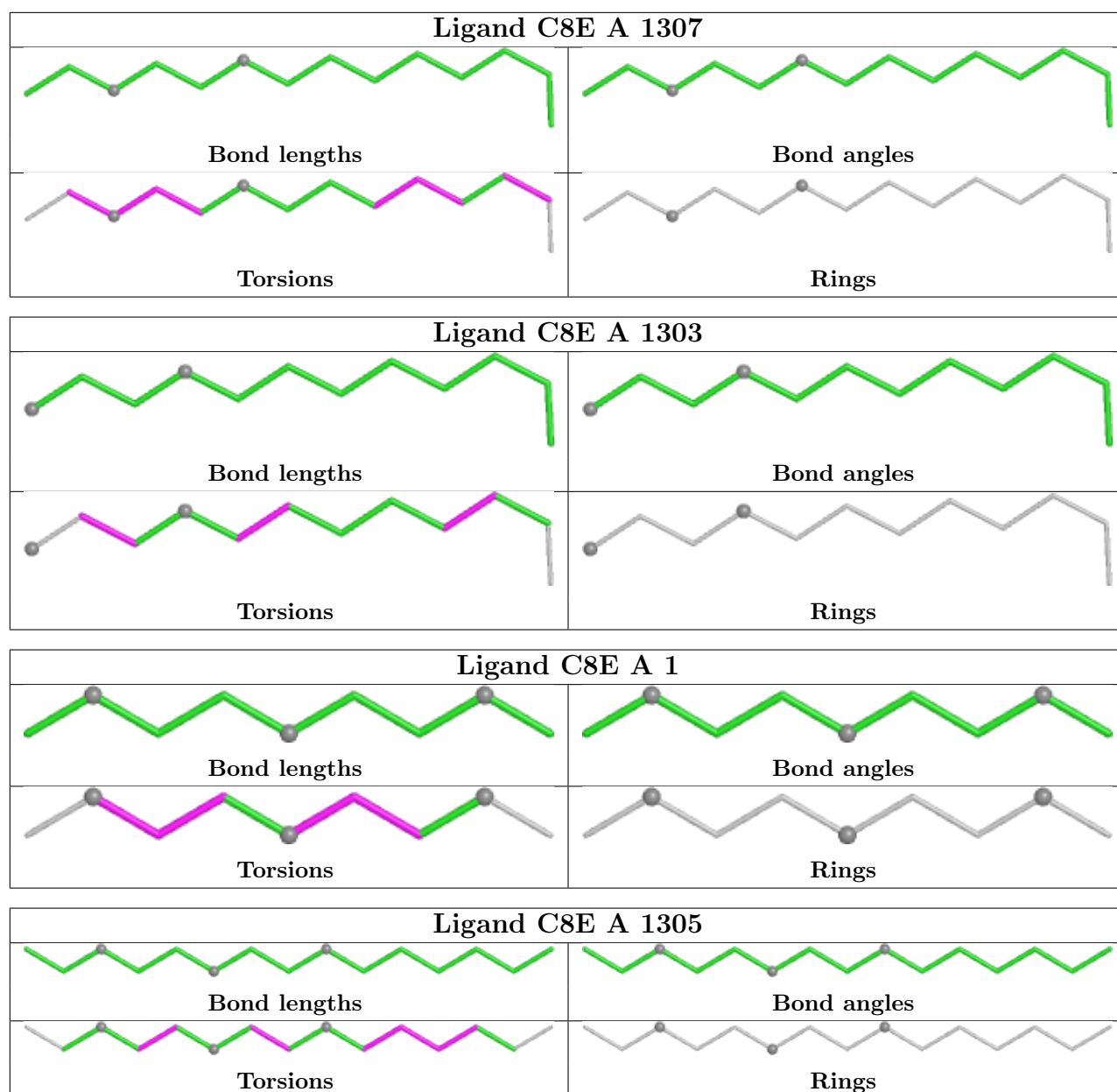
There are no ring outliers.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1304	C8E	1	0
2	A	1302	C8E	1	0
2	A	1	C8E	1	0

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





5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data [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	306/313 (97%)	0.49	15 (4%) 35 31	53, 66, 93, 111	0

All (15) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	995	HIS	10.3
1	A	996	HIS	5.5
1	A	1011	PHE	3.2
1	A	1190	MET	3.2
1	A	1136	PHE	3.1
1	A	1000	ASN	2.8
1	A	1135	THR	2.6
1	A	1015	TYR	2.5
1	A	1182	GLN	2.5
1	A	1013	VAL	2.5
1	A	1018	PHE	2.2
1	A	1186	LYS	2.1
1	A	1163	GLU	2.1
1	A	1189	GLY	2.0
1	A	1194	MET	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](#)

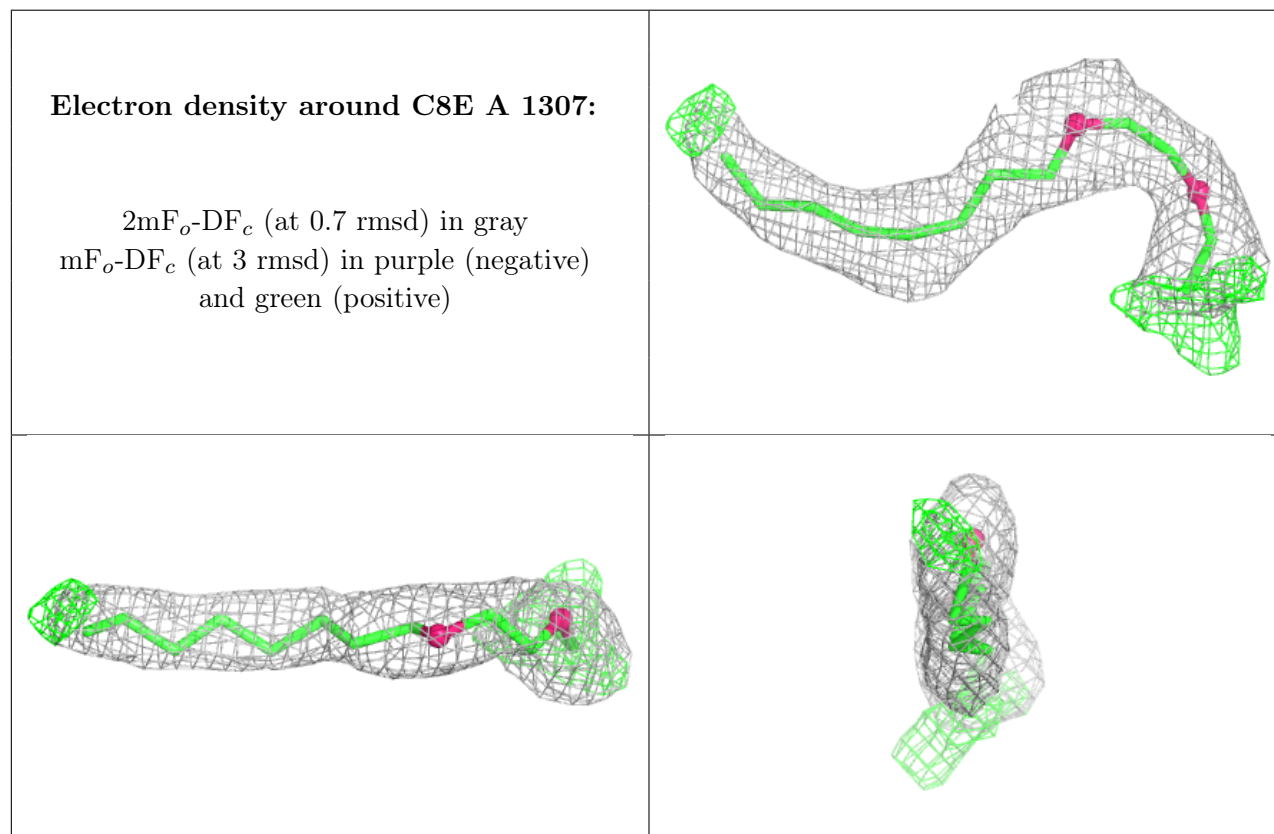
There are no oligosaccharides in this entry.

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.

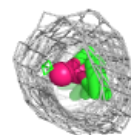
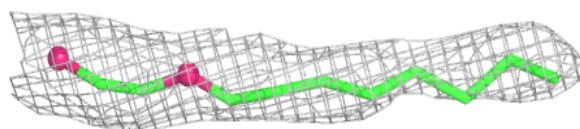
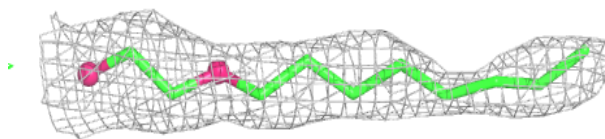
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	C8E	A	1307	14/21	0.80	0.26	90,102,113,113	0
2	C8E	A	1303	12/21	0.84	0.23	97,100,102,102	0
2	C8E	A	1	9/21	0.84	0.22	92,93,95,95	0
2	C8E	A	1305	15/21	0.85	0.20	68,83,98,99	0
2	C8E	A	1304	17/21	0.85	0.26	87,92,99,99	0
2	C8E	A	1306	13/21	0.87	0.21	77,85,99,99	0
2	C8E	A	1301	19/21	0.87	0.18	67,81,93,94	0
2	C8E	A	1302	12/21	0.92	0.15	61,65,70,71	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.

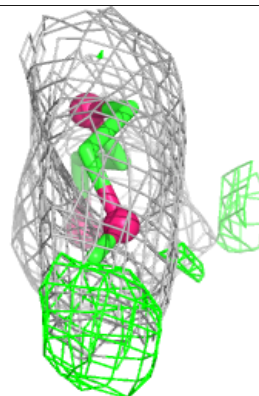
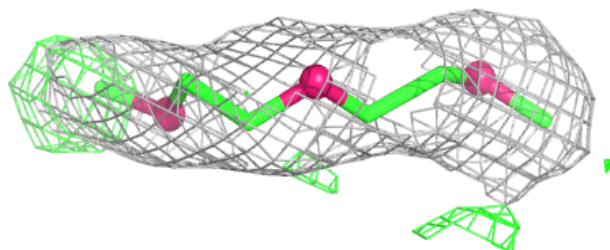
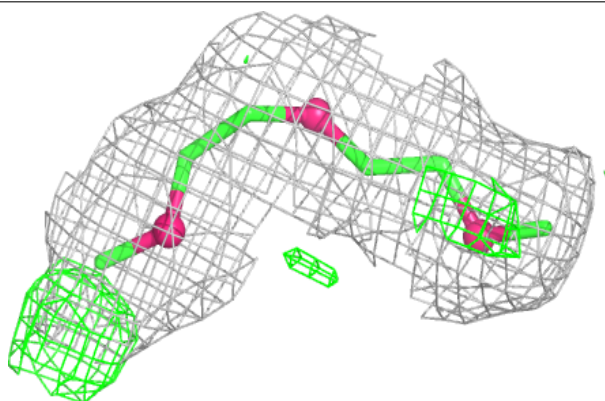


Electron density around C8E A 1303:

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

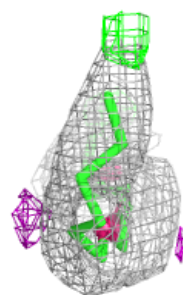
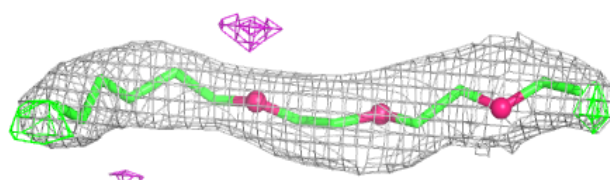
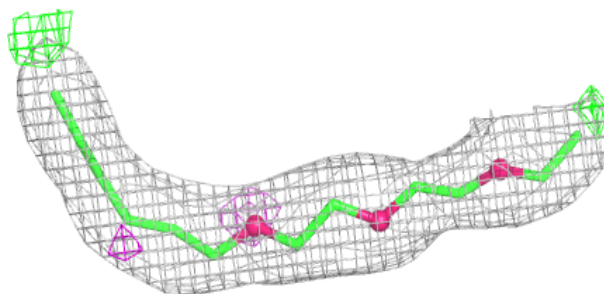
**Electron density around C8E A 1:**

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

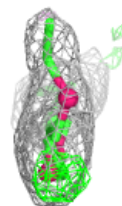
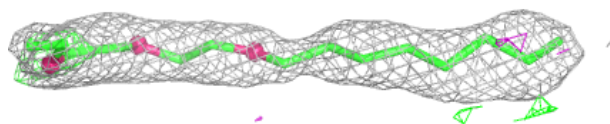


Electron density around C8E A 1305:

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

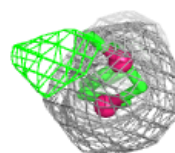
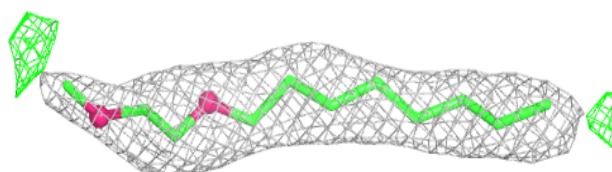
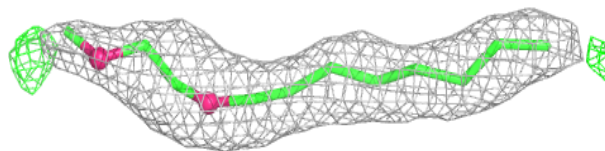
**Electron density around C8E A 1304:**

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

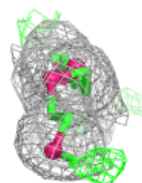
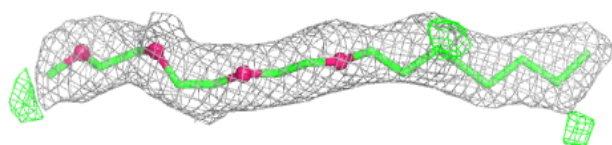
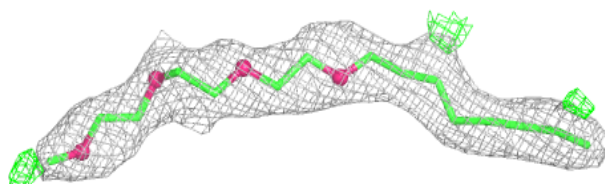


Electron density around C8E A 1306:

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

**Electron density around C8E A 1301:**

$2mF_o-DF_c$ (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.