



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 09:09 AM UTC

PDB ID : 1RP3 / pdb_00001rp3
Title : Cocrystal structure of the flagellar sigma/anti-sigma complex, Sigma-28/FlgM
Authors : Sorenson, M.K.; Ray, S.S.; Darst, S.A.
Deposited on : 2003-12-02
Resolution : 2.30 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 ⓘ 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
Xtriage (Phenix) : 2.0
EDS : 3.0
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

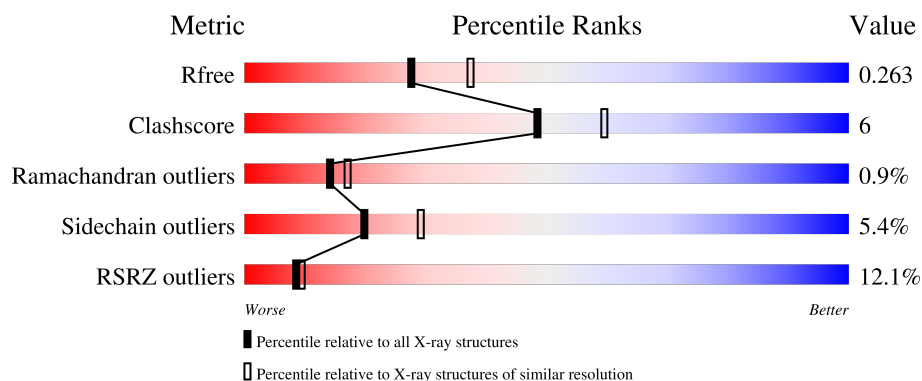
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	239	7% 82% 15% ..
1	C	239	8% 86% 11% ..
1	E	239	10% 82% 13% ..
1	G	239	7% 79% 13% 5%
2	B	88	24% 68% 16% 13%

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
2	D	88	
2	F	88	
2	H	88	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 9110 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 RNA polymerase sigma factor SIGMA-28 (FliA).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	235	Total	C	N	O	S	0	0	0
			1807	1160	303	343	1			
1	C	234	Total	C	N	O	S	0	0	0
			1789	1140	306	342	1			
1	E	235	Total	C	N	O	S	0	0	0
			1788	1144	299	344	1			
1	G	226	Total	C	N	O	S	0	0	0
			1749	1121	298	329	1			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	cloning artifact	UNP O67268
A	-1	SER	-	cloning artifact	UNP O67268
A	0	HIS	-	cloning artifact	UNP O67268
C	-2	GLY	-	cloning artifact	UNP O67268
C	-1	SER	-	cloning artifact	UNP O67268
C	0	HIS	-	cloning artifact	UNP O67268
E	-2	GLY	-	cloning artifact	UNP O67268
E	-1	SER	-	cloning artifact	UNP O67268
E	0	HIS	-	cloning artifact	UNP O67268
G	-2	GLY	-	cloning artifact	UNP O67268
G	-1	SER	-	cloning artifact	UNP O67268
G	0	HIS	-	cloning artifact	UNP O67268

- Molecule 2 is a protein called anti sigma factor FlgM.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	B	77	Total	C	N	O	0	0	0
			531	337	86	108			
2	D	70	Total	C	N	O	0	0	0
			466	299	77	90			

Continued on next page...

Continued from previous page...

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	F	64	Total	C	N	O	0	0	0
			428	274	69	85			
2	H	70	Total	C	N	O	0	0	0
			479	306	82	91			

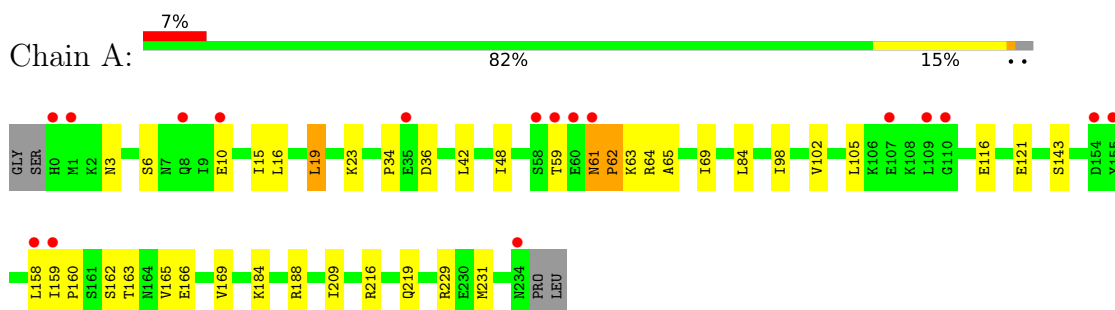
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	21	Total	O	0	0
			21	21		
3	B	4	Total	O	0	0
			4	4		
3	C	17	Total	O	0	0
			17	17		
3	E	16	Total	O	0	0
			16	16		
3	G	14	Total	O	0	0
			14	14		
3	H	1	Total	O	0	0
			1	1		

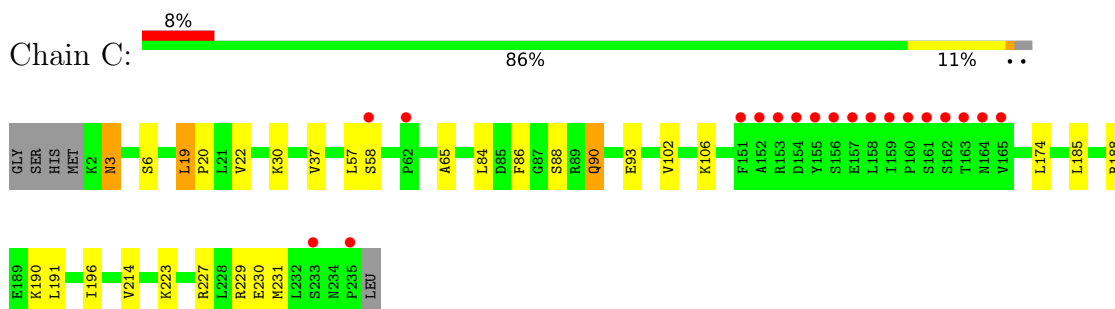
3 Residue-property plots

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.

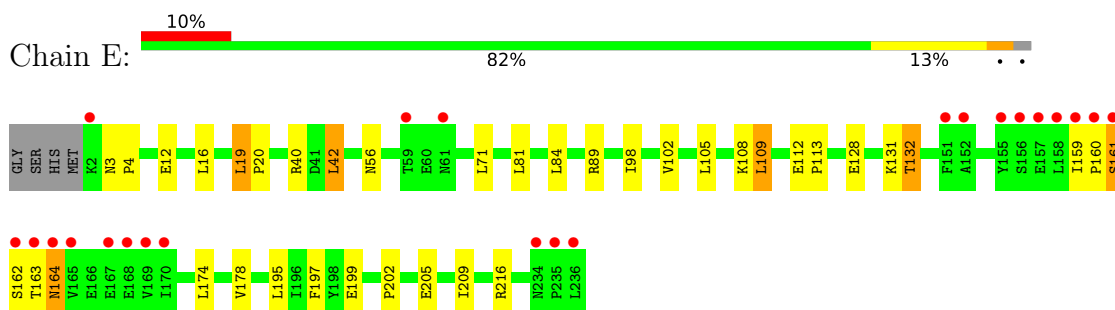
- Molecule 1: RNA polymerase sigma factor SIGMA-28 (FlhA)



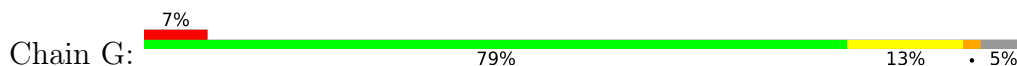
- Molecule 1: RNA polymerase sigma factor SIGMA-28 (FlhA)

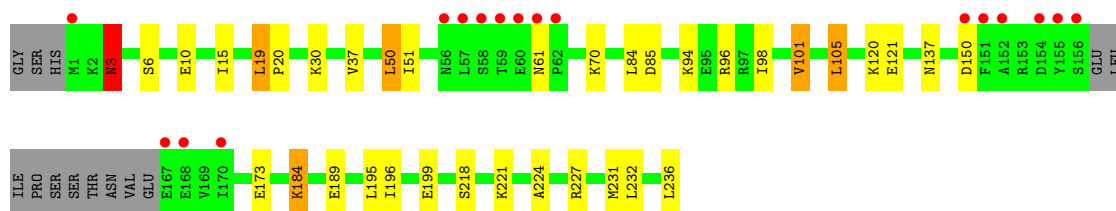


- Molecule 1: RNA polymerase sigma factor SIGMA-28 (FlhA)

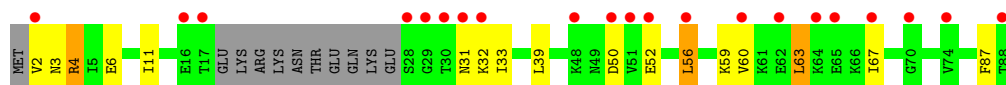


- Molecule 1: RNA polymerase sigma factor SIGMA-28 (FlhA)

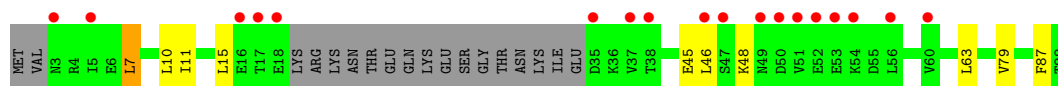




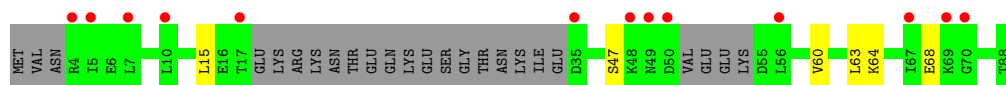
• Molecule 2: anti sigma factor FlgM



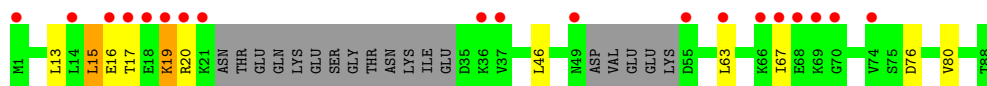
• Molecule 2: anti sigma factor FlgM



• Molecule 2: anti sigma factor FlgM



• Molecule 2: anti sigma factor FlgM



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	76.39Å 119.67Å 100.06Å 90.00° 107.00° 90.00°	Depositor
Resolution (Å)	29.92 – 2.30 29.92 – 2.30	Depositor EDS
% Data completeness (in resolution range)	92.5 (29.92-2.30) 92.5 (29.92-2.30)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.60 (at 2.20Å)	Xtriage
Refinement program	CNS 1.1, REFMAC 5.1.24	Depositor
R, R_{free}	0.242 , 0.262 0.243 , 0.263	Depositor DCC
R_{free} test set	4095 reflections (4.72%)	wwPDB-VP
Wilson B-factor (Å ²)	31.2	Xtriage
Anisotropy	0.662	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 39.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	9110	wwPDB-VP
Average B, all atoms (Å ²)	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.41% 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](#)

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	0.49	0/1830	0.89	2/2478 (0.1%)
1	C	0.49	0/1811	0.88	4/2453 (0.2%)
1	E	0.51	0/1811	0.92	2/2454 (0.1%)
1	G	0.48	0/1769	0.95	4/2386 (0.2%)
2	B	0.41	0/532	0.90	2/721 (0.3%)
2	D	0.41	0/467	0.90	1/633 (0.2%)
2	F	0.42	0/428	0.92	0/577
2	H	0.67	1/479 (0.2%)	1.09	3/645 (0.5%)
All	All	0.49	1/9127 (0.0%)	0.92	18/12347 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	H	20	ARG	CA-CB	-6.48	1.43	1.53

The worst 5 of 18 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	H	16	GLU	N-CA-C	-12.98	95.87	112.23
1	E	161	SER	N-CA-C	8.90	122.63	110.35
1	C	86	PHE	N-CA-C	6.05	117.54	111.07
1	G	85	ASP	N-CA-C	6.01	120.12	113.21
2	H	15	LEU	N-CA-C	5.87	120.29	113.18

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	1807	0	1817	25	0
1	C	1789	0	1772	19	0
1	E	1788	0	1748	22	0
1	G	1749	0	1771	17	0
2	B	531	0	477	13	0
2	D	466	0	395	6	0
2	F	428	0	371	4	0
2	H	479	0	429	5	0
3	A	21	0	0	2	0
3	B	4	0	0	0	0
3	C	17	0	0	1	0
3	E	16	0	0	0	0
3	G	14	0	0	0	0
3	H	1	0	0	0	0
All	All	9110	0	8780	98	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 6.

The worst 5 of 98 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:C:223:LYS:HE2	1:C:227:ARG:HH22	1.39	0.87
1:C:223:LYS:HE2	1:C:227:ARG:NH2	1.92	0.84
1:A:105:LEU:HD11	1:A:121:GLU:HG3	1.62	0.81
1:C:88:SER:HB2	1:C:90:GLN:HE21	1.47	0.80
1:E:128:GLU:O	1:E:132:THR:HG22	1.85	0.77

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	233/239 (98%)	227 (97%)	5 (2%)	1 (0%)	30	38
1	C	232/239 (97%)	225 (97%)	6 (3%)	1 (0%)	30	38
1	E	233/239 (98%)	226 (97%)	5 (2%)	2 (1%)	14	17
1	G	222/239 (93%)	219 (99%)	2 (1%)	1 (0%)	24	31
2	B	73/88 (83%)	62 (85%)	6 (8%)	5 (7%)	1	0
2	D	66/88 (75%)	65 (98%)	0	1 (2%)	8	8
2	F	58/88 (66%)	56 (97%)	2 (3%)	0	100	100
2	H	64/88 (73%)	61 (95%)	3 (5%)	0	100	100
All	All	1181/1308 (90%)	1141 (97%)	29 (2%)	11 (1%)	14	17

5 of 11 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	62	PRO
2	B	31	ASN
1	E	164	ASN
2	B	4	ARG
2	B	52	GLU

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	188/219 (86%)	180 (96%)	8 (4%)	26	39
1	C	183/219 (84%)	175 (96%)	8 (4%)	25	38
1	E	179/219 (82%)	170 (95%)	9 (5%)	22	33
1	G	180/219 (82%)	167 (93%)	13 (7%)	13	18
2	B	48/83 (58%)	45 (94%)	3 (6%)	16	23
2	D	35/83 (42%)	31 (89%)	4 (11%)	5	6
2	F	35/83 (42%)	34 (97%)	1 (3%)	37	55

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	H	39/83 (47%)	37 (95%)	2 (5%)	21	32
All	All	887/1208 (73%)	839 (95%)	48 (5%)	20	29

5 of 48 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	105	LEU
1	G	19	LEU
1	E	109	LEU
2	F	63	LEU
1	G	70	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 13 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	137	ASN
1	C	234	ASN
1	G	137	ASN
1	G	3	ASN
1	G	28	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 [i](#)

There are no ligands in this entry.

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	235/239 (98%)	0.36	17 (7%) 21 23	23, 47, 73, 91	0
1	C	234/239 (97%)	0.45	19 (8%) 18 19	26, 44, 90, 116	0
1	E	235/239 (98%)	0.43	23 (9%) 13 14	25, 43, 103, 119	0
1	G	226/239 (94%)	0.29	17 (7%) 20 22	26, 43, 88, 100	0
2	B	77/88 (87%)	1.16	21 (27%) 1 1	28, 67, 102, 108	0
2	D	70/88 (79%)	1.24	18 (25%) 1 2	32, 65, 101, 104	0
2	F	64/88 (72%)	1.20	13 (20%) 3 3	33, 68, 82, 89	0
2	H	70/88 (79%)	1.17	19 (27%) 1 1	35, 62, 107, 130	0
All	All	1211/1308 (92%)	0.57	147 (12%) 8 9	23, 47, 92, 130	0

The worst 5 of 147 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	G	59	THR	6.7
1	C	154	ASP	6.5
1	E	236	LEU	6.4
1	C	155	TYR	5.9
1	C	161	SER	5.8

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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.