



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 06:03 AM UTC

PDB ID : 6UTX / pdb\_00006utx  
Title : E. coli sigma-S transcription initiation complex with an empty bubble ("Old" crystal)  
Authors : Zuo, Y.; De, S.; Steitz, T.A.  
Deposited on : 2019-10-30  
Resolution : 4.05 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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0  
Xtrriage (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

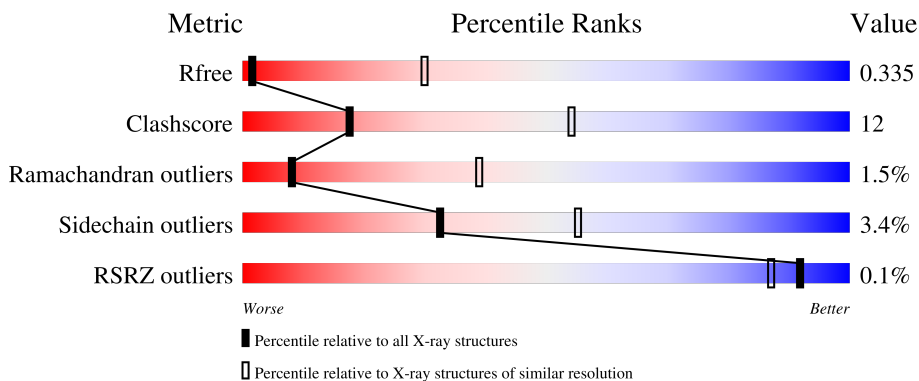
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 4.05 Å.

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




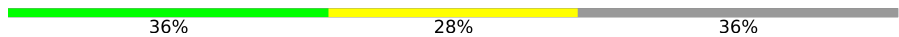

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	180053	1183 (4.32-3.80)
Clashscore	190562	1231 (4.32-3.80)
Ramachandran outliers	187476	1154 (4.32-3.80)
Sidechain outliers	187428	1144 (4.32-3.80)
RSRZ outliers	180081	1182 (4.32-3.80)

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  $\geq 3$ , 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	AAA	242	
1	BBB	242	
2	CCC	1342	
3	DDD	1407	
4	EEE	90	

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Mol	Chain	Length	Quality of chain
5	FFF	336	
6	111	50	
7	222	50	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
8	ZN	DDD	1502	-	-	X	-

## 2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 28841 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 DNA-directed RNA polymerase subunit alpha.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	AAA	230	Total 1787	C 1112	N 317	O 352	S 6	0	0	0
1	BBB	228	Total 1767	C 1100	N 312	O 349	S 6	0	0	0

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
AAA	-6	ALA	-	expression tag	UNP P0A7Z4
AAA	-5	HIS	-	expression tag	UNP P0A7Z4
AAA	-4	HIS	-	expression tag	UNP P0A7Z4
AAA	-3	HIS	-	expression tag	UNP P0A7Z4
AAA	-2	HIS	-	expression tag	UNP P0A7Z4
AAA	-1	HIS	-	expression tag	UNP P0A7Z4
AAA	0	HIS	-	expression tag	UNP P0A7Z4
BBB	-6	ALA	-	expression tag	UNP P0A7Z4
BBB	-5	HIS	-	expression tag	UNP P0A7Z4
BBB	-4	HIS	-	expression tag	UNP P0A7Z4
BBB	-3	HIS	-	expression tag	UNP P0A7Z4
BBB	-2	HIS	-	expression tag	UNP P0A7Z4
BBB	-1	HIS	-	expression tag	UNP P0A7Z4
BBB	0	HIS	-	expression tag	UNP P0A7Z4

- Molecule 2 is a protein called DNA-directed RNA polymerase subunit beta.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	CCC	1340	Total 10570	C 6631	N 1841	O 2055	S 43	0	0	0

- Molecule 3 is a protein called DNA-directed RNA polymerase subunit beta'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	DDD	1350	10478	6578	1867	1984	49	0	0	0

- Molecule 4 is a protein called DNA-directed RNA polymerase subunit omega.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	EEE	79	627	382	118	126	1	0	0	0

- Molecule 5 is a protein called RNA polymerase sigma factor RpoS.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
5	FFF	277	2253	1411	415	423	4	0	0	0

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
FFF	2	GLY	SER	conflict	UNP P13445
FFF	33	GLU	GLN	conflict	UNP P13445
FFF	329	LEU	-	expression tag	UNP P13445
FFF	330	GLU	-	expression tag	UNP P13445
FFF	331	HIS	-	expression tag	UNP P13445
FFF	332	HIS	-	expression tag	UNP P13445
FFF	333	HIS	-	expression tag	UNP P13445
FFF	334	HIS	-	expression tag	UNP P13445
FFF	335	HIS	-	expression tag	UNP P13445
FFF	336	HIS	-	expression tag	UNP P13445

- Molecule 6 is a DNA chain called Synthetic DNA 50-MER (promoter non-template strand).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
6	111	32	661	314	121	194	32	0	0	0

- Molecule 7 is a DNA chain called Synthetic DNA 50-MER (promoter template strand).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
7	222	34	695	332	127	203	33	0	0	0

- Molecule 8 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	DDD	2	Total	Zn	0	0
			2	2		

- Molecule 9 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

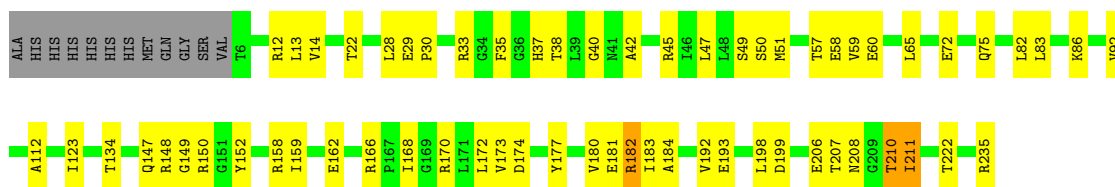
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	DDD	1	Total	Mg	0	0
			1	1		

### 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.

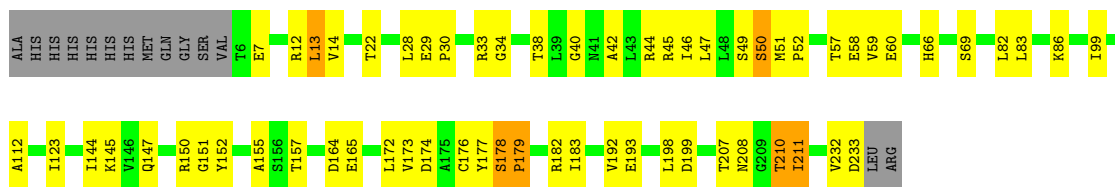
- Molecule 1: DNA-directed RNA polymerase subunit alpha

Chain AAA: 




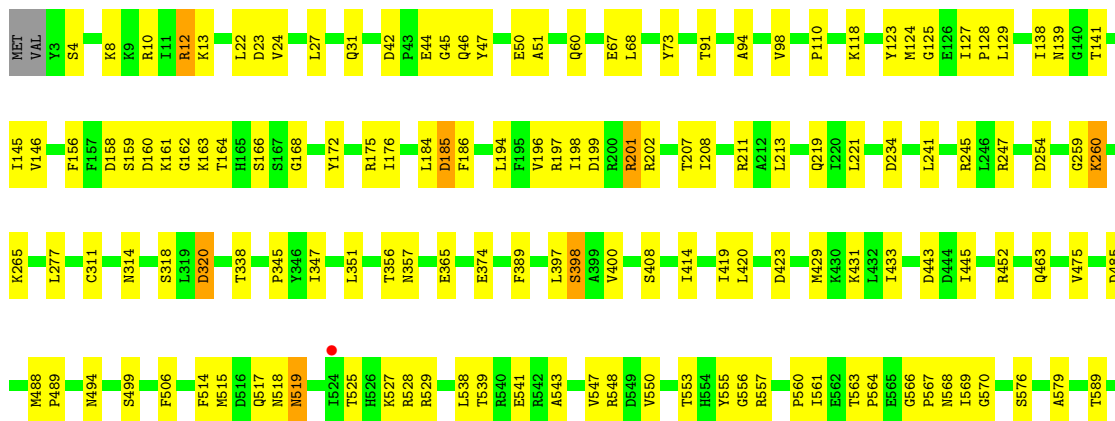
- Molecule 1: DNA-directed RNA polymerase subunit alpha

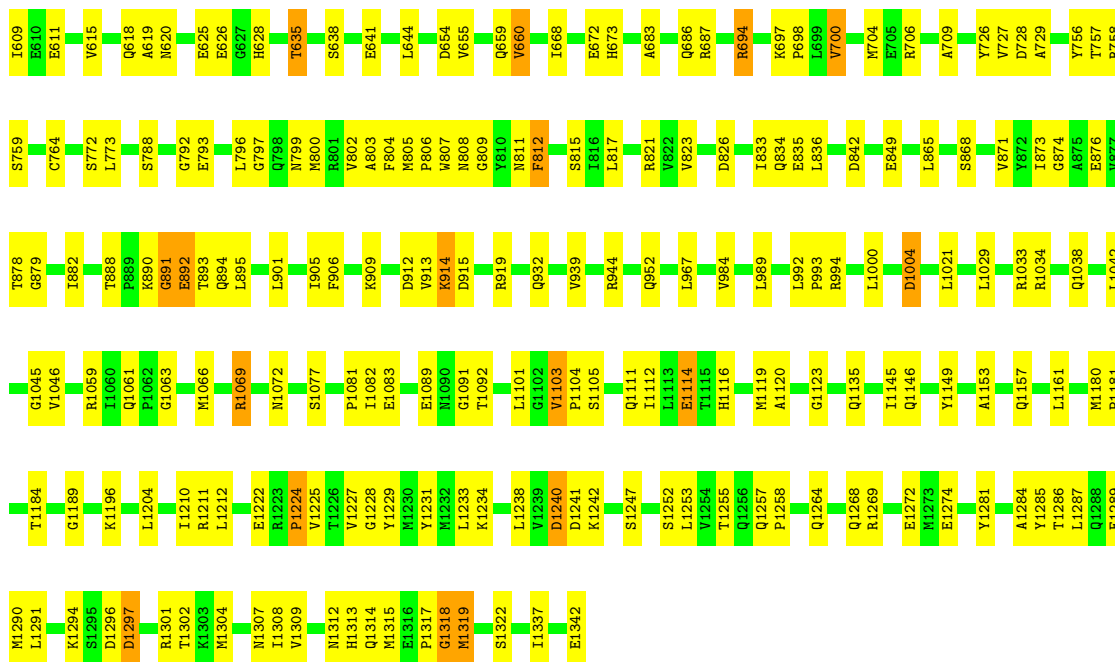
Chain BBB: 



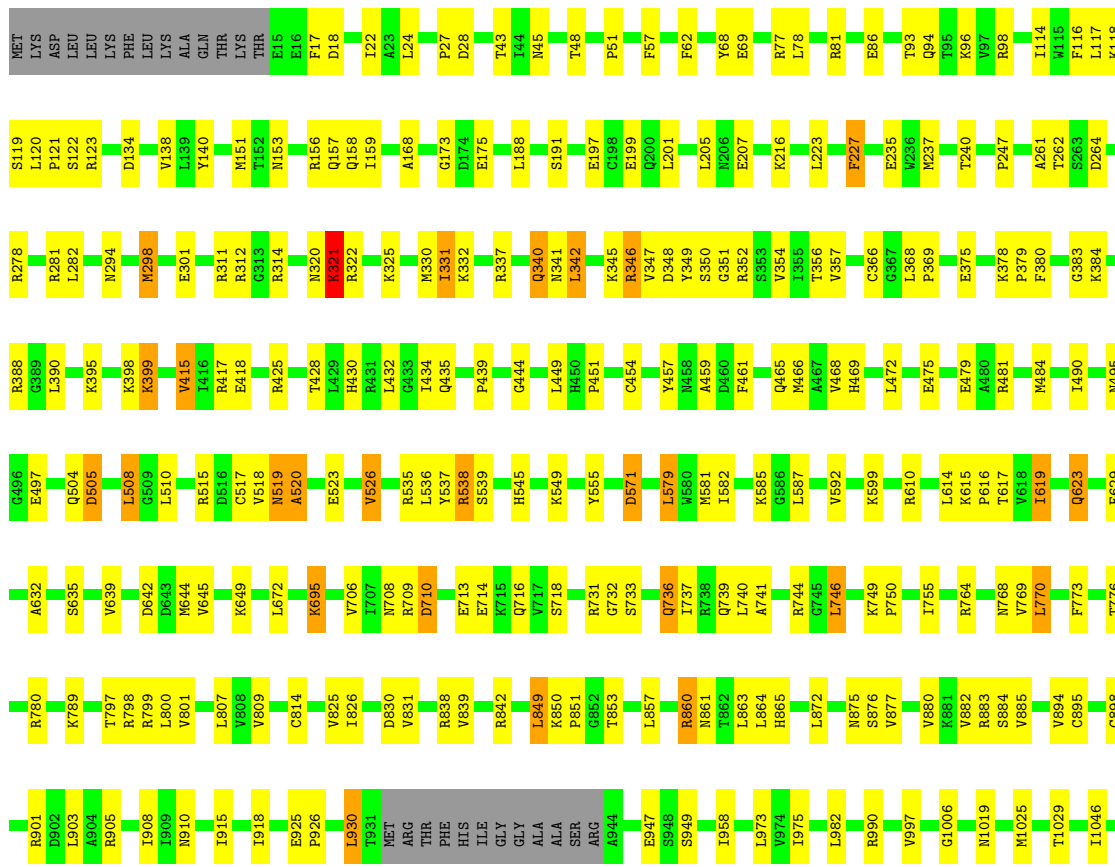
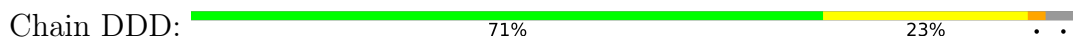
- Molecule 2: DNA-directed RNA polymerase subunit beta

Chain CCC: 





• Molecule 3: DNA-directed RNA polymerase subunit beta'





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	132.07Å 153.30Å 230.90Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.90 – 4.05 48.90 – 4.05	Depositor EDS
% Data completeness (in resolution range)	98.9 (48.90-4.05) 98.9 (48.90-4.05)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.07 (at 4.00Å)	Xtrriage
Refinement program	REFMAC 5.8.0257	Depositor
R, $R_{free}$	0.279 , 0.349 0.274 , 0.335	Depositor DCC
$R_{free}$ test set	1841 reflections (4.74%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	161.0	Xtrriage
Anisotropy	0.664	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.27 , 234.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.35$ , $\langle L^2 \rangle = 0.18$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	28841	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	268.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.13% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: ZN, MG

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	AAA	0.97	0/1809	1.17	0/2450
1	BBB	0.96	0/1789	1.20	2/2425 (0.1%)
2	CCC	0.92	0/10739	1.26	8/14489 (0.1%)
3	DDD	0.94	0/10636	1.27	4/14362 (0.0%)
4	EEE	0.93	0/629	1.34	1/847 (0.1%)
5	FFF	0.99	0/2282	1.30	0/3076
6	111	0.31	0/741	0.61	0/1143
7	222	0.32	0/779	0.58	0/1201
All	All	0.92	0/29404	1.23	15/39993 (0.0%)

There are no bond length outliers.

The worst 5 of 15 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	DDD	706	VAL	N-CA-C	-7.57	105.46	112.43
1	BBB	179	PRO	N-CA-C	-6.97	103.84	113.53
3	DDD	331	ILE	N-CA-C	-6.62	106.68	113.10
2	CCC	414	ILE	N-CA-C	-5.88	105.99	111.45
3	DDD	118	LYS	N-CA-C	-5.84	106.28	113.41

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	AAA	1787	0	1813	71	0
1	BBB	1767	0	1789	67	0
2	CCC	10570	0	10582	297	0
3	DDD	10478	0	10691	321	0
4	EEE	627	0	634	10	0
5	FFF	2253	0	2298	78	1
6	111	661	0	362	25	0
7	222	695	0	385	25	0
8	DDD	2	0	0	2	0
9	DDD	1	0	0	0	0
All	All	28841	0	28554	710	1

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 12.

The worst 5 of 710 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)
3:DDD:898:CYS:SG	8:DDD:1502:ZN:ZN	1.16	1.32
2:CCC:894:GLN:NE2	3:DDD:69:GLU:OE2	1.85	1.08
2:CCC:563:THR:OG1	2:CCC:569:ILE:O	1.74	1.05
2:CCC:560:PRO:O	3:DDD:780:ARG:NH2	1.90	1.04
2:CCC:891:GLY:O	2:CCC:892:GLU:C	2.04	1.00

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

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:FFF:67:TYR:O	5:FFF:299:ARG:NH2[3_644]	1.65	0.55

## 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	AAA	228/242 (94%)	202 (89%)	19 (8%)	7 (3%)	3	25
1	BBB	226/242 (93%)	204 (90%)	16 (7%)	6 (3%)	4	28
2	CCC	1338/1342 (100%)	1193 (89%)	124 (9%)	21 (2%)	7	38
3	DDD	1346/1407 (96%)	1210 (90%)	118 (9%)	18 (1%)	9	41
4	EEE	77/90 (86%)	70 (91%)	7 (9%)	0	100	100
5	FFF	275/336 (82%)	248 (90%)	25 (9%)	2 (1%)	18	55
All	All	3490/3659 (95%)	3127 (90%)	309 (9%)	54 (2%)	8	39

5 of 54 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	CCC	161	LYS
2	CCC	1319	MET
3	DDD	519	ASN
3	DDD	710	ASP
3	DDD	861	ASN

### 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	AAA	198/208 (95%)	190 (96%)	8 (4%)	28	50
1	BBB	196/208 (94%)	192 (98%)	4 (2%)	48	66
2	CCC	1155/1157 (100%)	1124 (97%)	31 (3%)	39	60
3	DDD	1127/1168 (96%)	1082 (96%)	45 (4%)	28	50
4	EEE	67/74 (90%)	64 (96%)	3 (4%)	24	48
5	FFF	240/292 (82%)	231 (96%)	9 (4%)	29	51
All	All	2983/3107 (96%)	2883 (97%)	100 (3%)	32	55

5 of 100 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	DDD	384	LYS

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Mol	Chain	Res	Type
3	DDD	619	ILE
5	FFF	325	GLU
3	DDD	399	LYS
3	DDD	549	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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](#)

Of 3 ligands modelled in this entry, 3 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	AAA	230/242 (95%)	-0.68	0 <a href="#">100</a> <a href="#">100</a>	207, 270, 374, 441	0
1	BBB	228/242 (94%)	-0.63	0 <a href="#">100</a> <a href="#">100</a>	201, 298, 374, 400	0
2	CCC	1340/1342 (99%)	-0.79	1 (0%) <a href="#">92</a> <a href="#">87</a>	121, 230, 363, 462	0
3	DDD	1350/1407 (95%)	-0.82	1 (0%) <a href="#">92</a> <a href="#">87</a>	127, 252, 425, 497	0
4	EEE	79/90 (87%)	-0.96	0 <a href="#">100</a> <a href="#">100</a>	221, 293, 450, 469	0
5	FFF	277/336 (82%)	-0.78	0 <a href="#">100</a> <a href="#">100</a>	182, 279, 432, 486	0
6	111	32/50 (64%)	-0.54	0 <a href="#">100</a> <a href="#">100</a>	251, 304, 379, 395	0
7	222	34/50 (68%)	-0.50	0 <a href="#">100</a> <a href="#">100</a>	224, 288, 383, 409	0
All	All	3570/3759 (94%)	-0.78	2 (0%) <a href="#">92</a> <a href="#">87</a>	121, 256, 410, 497	0

All (2) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	DDD	1332	LEU	2.4
2	CCC	524	ILE	2.3

### 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, 95<sup>th</sup> 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
8	ZN	DDD	1501	1/1	0.98	0.07	332,332,332,332	0
8	ZN	DDD	1502	1/1	0.99	0.03	268,268,268,268	0
9	MG	DDD	1503	1/1	0.99	0.02	95,95,95,95	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.