



wwPDB X-ray Structure Validation Summary Report ⓘ

Aug 22, 2017 – 04:33 PM EDT

PDB ID : 5BYH
Title : Crystal Structure of Escherichia coli RNA polymerase - Sigma54 Holoenzyme complex
Authors : Zhang, X.; Buck, M.; Darbari, V.C.; Yang, Y.; Zhang, N.; Lu, D.; Glyde, R.; Wang, Y.; Winkelman, J.; Gourse, R.L.; Murakami, K.S.
Deposited on : unknown
Resolution : 3.76 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20029824
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	rb-20029824

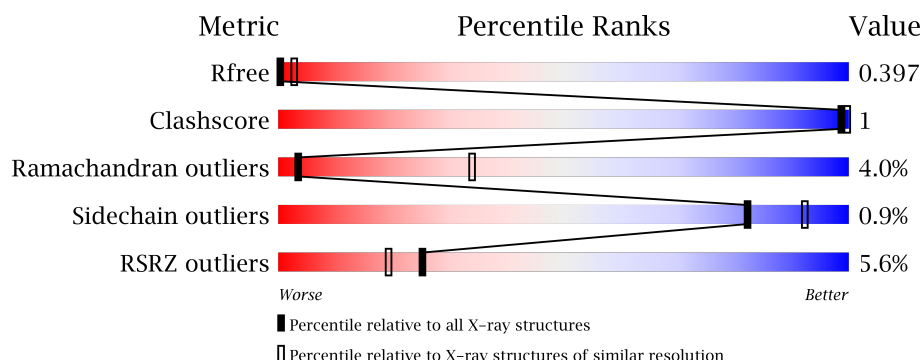
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.76 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}	100719	1423 (4.02-3.50)
Clashscore	112137	1087 (4.00-3.52)
Ramachandran outliers	110173	1047 (4.00-3.52)
Sidechain outliers	110143	1041 (4.00-3.52)
RSRZ outliers	101464	1011 (4.00-3.52)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	329	<div> <div>2%</div> <div>87%</div> <div>5%</div> <div>7%</div> </div>
1	B	329	<div> <div>5%</div> <div>64%</div> <div>•</div> <div>34%</div> </div>
2	C	1342	<div> <div>7%</div> <div>95%</div> <div>• •</div> </div>
3	D	1407	<div> <div>4%</div> <div>93%</div> <div>• •</div> </div>
4	E	91	<div> <div>4%</div> <div>87%</div> <div>13%</div> </div>

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Mol	Chain	Length	Quality of chain
5	M	477	<div><div></div><div>8%</div><div></div><div>77%</div><div></div><div>9%</div><div>..</div><div>12%</div></div>

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 22900 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
1	A	305	Total	C	N	O	S	0	0	0
			1975	1233	346	391	5			
1	B	216	Total	C	N	O	S	0	0	0
			1485	917	271	292	5			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	1319	Total	C	N	O	S	0	1	0
			8347	5174	1507	1642	24			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	1372	Total	C	N	O	S	0	0	0
			7824	4771	1488	1552	13			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	E	79	Total	C	N	O	S	0	0	0
			623	379	116	127	1			

- Molecule 5 is a protein called RNA polymerase sigma-54 factor.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
5	M	421	Total	C	N	O	S	Se	0	0	0
			2645	1649	457	530	2	7			

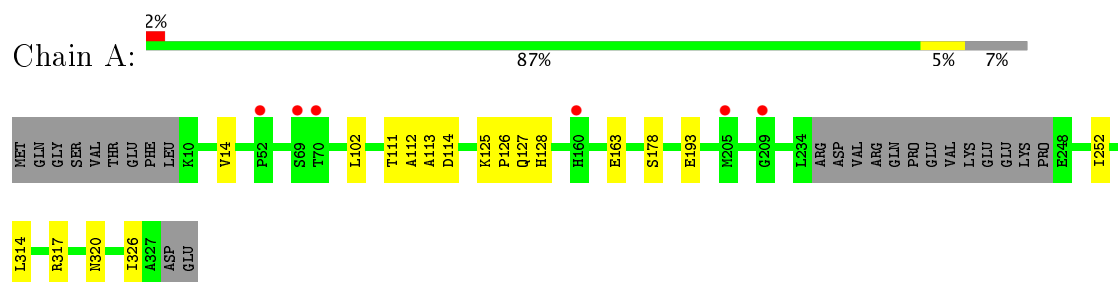
- Molecule 6 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	D	1	Total 1	Zn 1	0	0

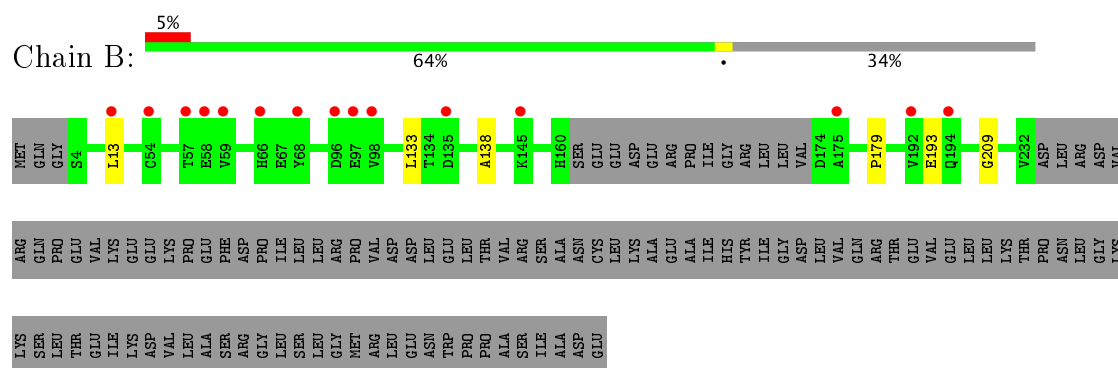
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

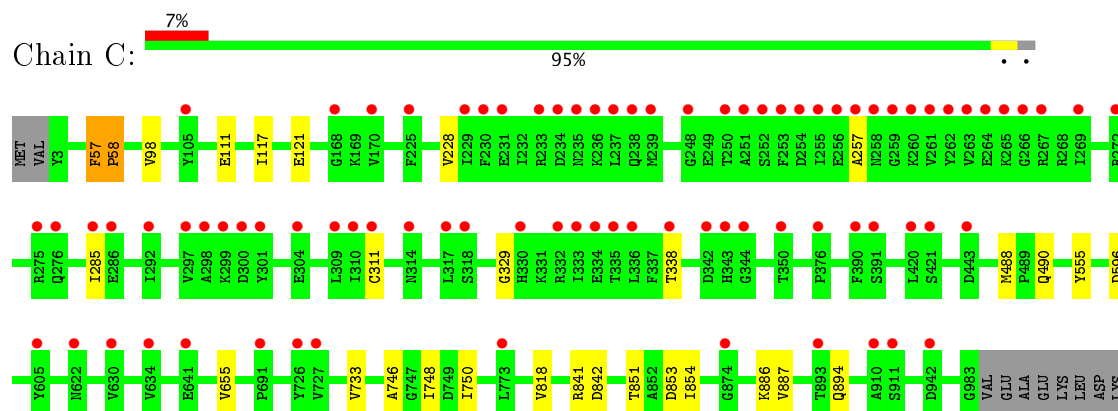
- Molecule 1: DNA-directed RNA polymerase subunit alpha

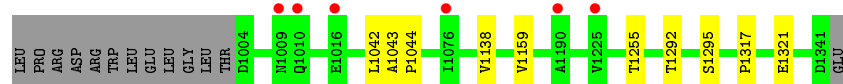


- Molecule 1: DNA-directed RNA polymerase subunit alpha

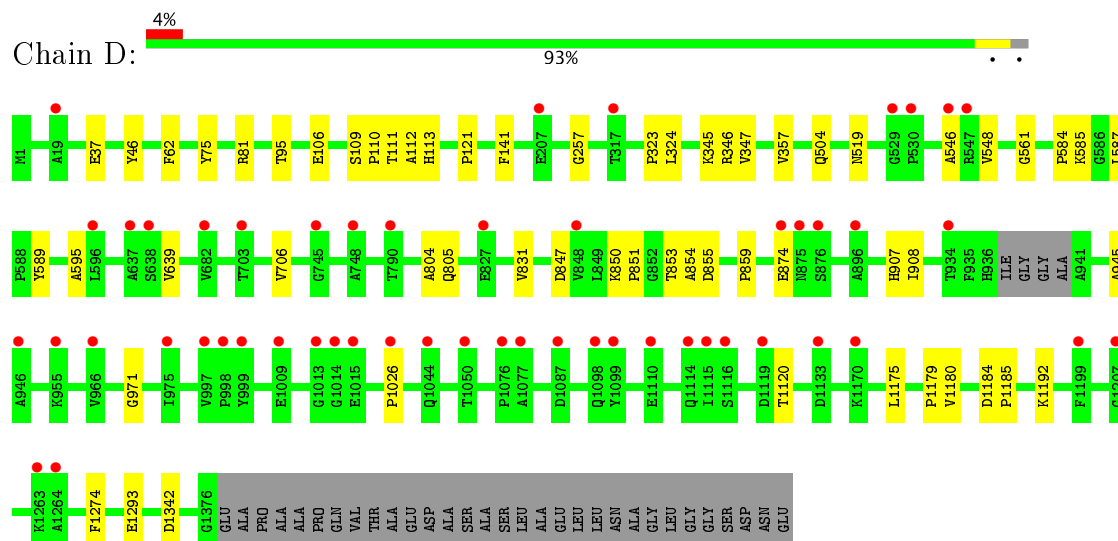


- Molecule 2: DNA-directed RNA polymerase subunit beta

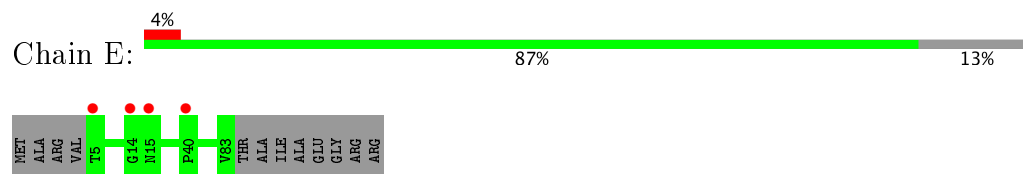




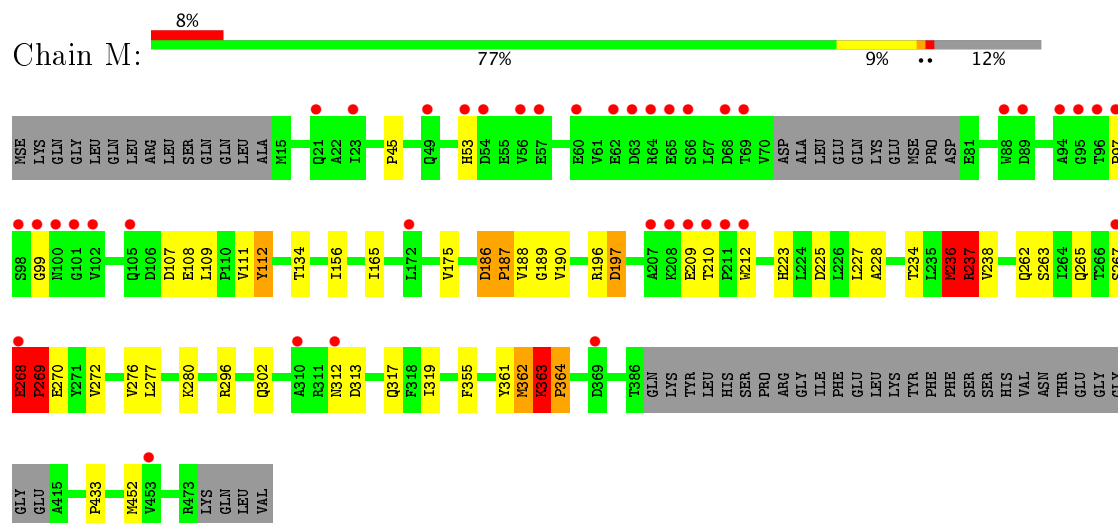
- Molecule 3: DNA-directed RNA polymerase subunit beta'



- Molecule 4: DNA-directed RNA polymerase subunit omega



- Molecule 5: RNA polymerase sigma-54 factor



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	208.48Å 151.52Å 195.28Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.64 – 3.76 29.64 – 3.76	Depositor EDS
% Data completeness (in resolution range)	98.4 (29.64-3.76) 98.5 (29.64-3.76)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.26 (at 3.75Å)	Xtriage
Refinement program	BUSTER-TNT BUSTER 2.10.2	Depositor
R, R_{free}	0.346 , 0.353 0.379 , 0.397	Depositor DCC
R_{free} test set	3074 reflections (4.93%)	DCC
Wilson B-factor (Å ²)	142.0	Xtriage
Anisotropy	0.740	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.22 , 185.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.85	EDS
Total number of atoms	22900	wwPDB-VP
Average B, all atoms (Å ²)	209.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.34% 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:
ZN

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	0/1999	0.58	0/2754
1	B	0.37	0/1502	0.57	0/2052
2	C	0.35	0/8473	0.54	2/11640 (0.0%)
3	D	0.34	0/7889	0.52	0/10883
4	E	0.36	0/625	0.52	0/842
5	M	0.41	0/2669	0.73	3/3675 (0.1%)
All	All	0.36	0/23157	0.56	5/31846 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
2	C	0	1
5	M	0	5
All	All	0	6

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
5	M	362	MSE	C-N-CA	6.49	137.92	121.70
5	M	236	MET	C-N-CA	6.28	137.41	121.70
2	C	841	ARG	C-N-CA	5.63	135.78	121.70
2	C	58	PRO	N-CA-C	-5.49	97.84	112.10
5	M	362	MSE	N-CA-C	5.21	125.06	111.00

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	C	57	PHE	Mainchain
5	M	268	GLU	Mainchain,Peptide
5	M	269	PRO	Mainchain
5	M	362	MSE	Peptide
5	M	363	LYS	Mainchain

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	1975	0	1687	2	0
1	B	1485	0	1322	1	0
2	C	8347	0	6487	3	0
3	D	7824	0	5283	2	0
4	E	623	0	622	0	0
5	M	2645	0	2081	17	0
6	D	1	0	0	0	0
All	All	22900	0	17482	24	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 1.

The worst 5 of 24 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)
5:M:363:LYS:HB3	5:M:364:PRO:CD	2.09	0.81
5:M:268:GLU:HG3	5:M:269:PRO:HD3	1.70	0.71
5:M:268:GLU:CG	5:M:269:PRO:HD3	2.20	0.70
5:M:363:LYS:HB3	5:M:364:PRO:HD3	1.88	0.55
5:M:268:GLU:CG	5:M:269:PRO:CD	2.89	0.51

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	301/329 (92%)	247 (82%)	43 (14%)	11 (4%)	4	36
1	B	212/329 (64%)	186 (88%)	23 (11%)	3 (1%)	13	54
2	C	1312/1342 (98%)	1106 (84%)	173 (13%)	33 (2%)	6	44
3	D	1368/1407 (97%)	1155 (84%)	159 (12%)	54 (4%)	3	34
4	E	77/91 (85%)	72 (94%)	5 (6%)	0	100	100
5	M	415/477 (87%)	298 (72%)	70 (17%)	47 (11%)	0	8
All	All	3685/3975 (93%)	3064 (83%)	473 (13%)	148 (4%)	3	34

5 of 148 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	C	57	PHE
2	C	121	GLU
2	C	555	TYR
2	C	842	ASP
2	C	887	VAL

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	159/286 (56%)	156 (98%)	3 (2%)	62	84
1	B	130/286 (46%)	129 (99%)	1 (1%)	85	93
2	C	567/1157 (49%)	567 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
3	D	332/1168 (28%)	330 (99%)	2 (1%)	89	95
4	E	66/75 (88%)	66 (100%)	0	100	100
5	M	186/413 (45%)	179 (96%)	7 (4%)	38	70
All	All	1440/3385 (42%)	1427 (99%)	13 (1%)	82	92

5 of 13 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	D	907	HIS
5	M	112	TYR
5	M	268	GLU
3	D	109	SER
5	M	237	ARG

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

Mol	Chain	Res	Type
1	A	227	GLN
2	C	1244	HIS

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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 1 ligands modelled in this entry, 1 is 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 [i](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
2	C	2

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	C	967:LEU	C	968:GLU	N	4.69
1	C	941:LYS	C	942:ASP	N	3.24

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

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	305/329 (92%)	0.06	6 (1%) 65 56	110, 223, 287, 299	0
1	B	216/329 (65%)	0.20	15 (6%) 18 13	31, 239, 294, 300	0
2	C	1319/1342 (98%)	0.16	89 (6%) 19 14	71, 208, 294, 297	0
3	D	1372/1407 (97%)	-0.10	52 (3%) 41 33	32, 195, 300, 300	0
4	E	79/91 (86%)	0.14	4 (5%) 29 23	130, 170, 281, 289	0
5	M	413/477 (86%)	0.25	40 (9%) 8 7	111, 214, 298, 300	0
All	All	3704/3975 (93%)	0.06	206 (5%) 25 19	31, 208, 300, 300	0

The worst 5 of 206 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	C	251	ALA	12.6
2	C	298	ALA	10.7
3	D	848	VAL	10.1
5	M	101	GLY	7.8
5	M	96	THR	7.2

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

There are no carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(\AA^2)	Q<0.9
6	ZN	D	1501	1/1	0.87	0.32	0.29	268,268,268,268	0

6.5 Other polymers [i](#)

There are no such residues in this entry.