



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 05:24 PM UTC

PDB ID : 3KDK / pdb_00003kdk
Title : Structure of the C-terminal domain of Bacillus subtilis MutL bound to Zn²⁺
Authors : Guarne, A.; Pillon, M.C.
Deposited on : 2009-10-23
Resolution : 2.26 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
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

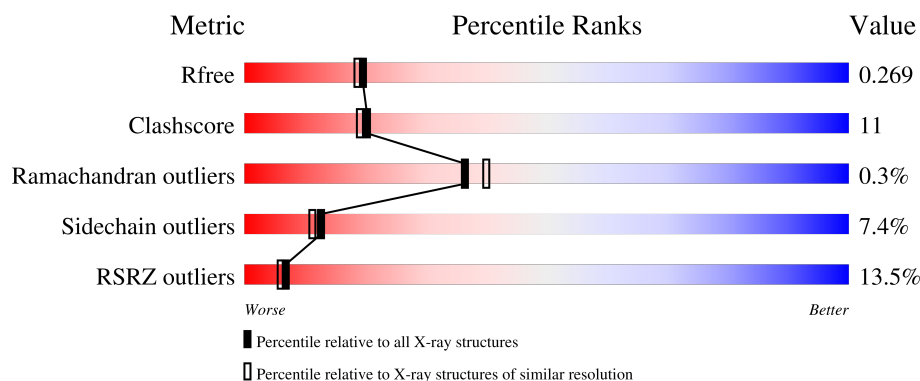
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.26 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	1898 (2.26-2.26)
Clashscore	190562	2005 (2.26-2.26)
Ramachandran outliers	187476	1965 (2.26-2.26)
Sidechain outliers	187428	1966 (2.26-2.26)
RSRZ outliers	180081	1898 (2.26-2.26)

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	197	22% 64% 25% 5% 6%
1	B	197	3% 74% 19% 7%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3120 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 mismatch repair protein mutL.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	186	Total	C	N	O	S	0	0	0
			1526	970	258	287	11			
1	B	184	Total	C	N	O	S	0	1	0
			1516	964	257	284	11			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	431	GLY	-	expression tag	UNP P49850
A	432	ALA	-	expression tag	UNP P49850
A	433	MET	-	expression tag	UNP P49850
B	431	GLY	-	expression tag	UNP P49850
B	432	ALA	-	expression tag	UNP P49850
B	433	MET	-	expression tag	UNP P49850

- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Zn	0	0
			2	2		
2	B	2	Total	Zn	0	0
			2	2		

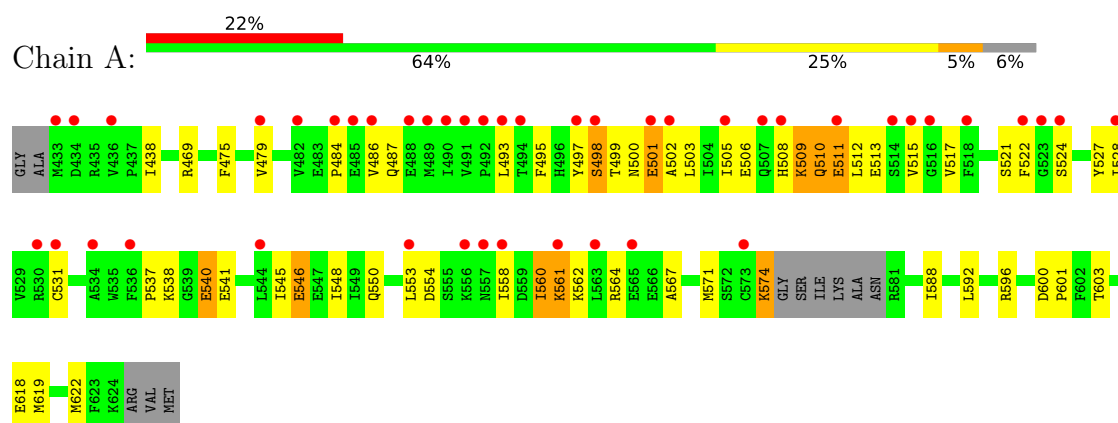
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	30	Total	O	0	0
			30	30		
3	B	44	Total	O	0	0
			44	44		

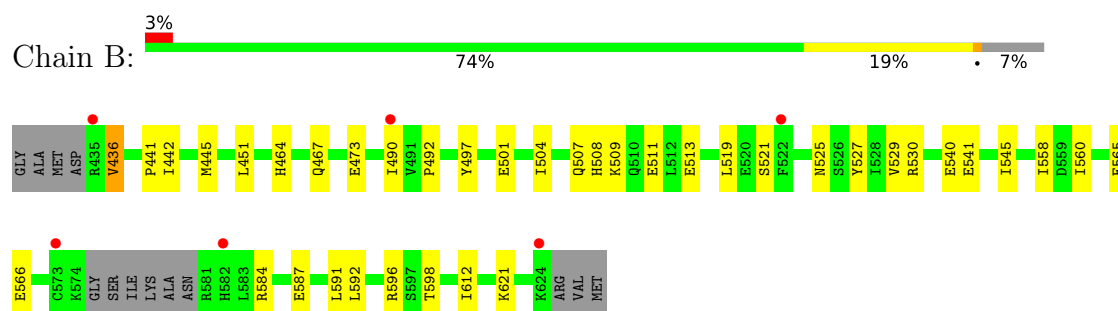
3 Residue-property plots [i](#)

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 mismatch repair protein mutL



- Molecule 1: DNA mismatch repair protein mutL



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	33.23Å 74.61Å 182.24Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	32.75 – 2.26 32.75 – 2.26	Depositor EDS
% Data completeness (in resolution range)	99.5 (32.75-2.26) 99.7 (32.75-2.26)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$	-	Xtriage
Refinement program	PHENIX (phenix.refine)	Depositor
R, R_{free}	0.214 , 0.269 0.217 , 0.269	Depositor DCC
R_{free} test set	1137 reflections (5.12%)	wwPDB-VP
Wilson B-factor (Å ²)	(Not available)	Xtriage
Anisotropy	(Not available)	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 54.3	EDS
L-test for twinning ¹	$\langle L \rangle =$ (Not available), $\langle L^2 \rangle =$ (Not available)	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	3120	wwPDB-VP
Average B, all atoms (Å ²)	64.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *(Not available)*

¹Theoretical 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

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	0.33	0/1559	0.72	0/2101
1	B	0.36	0/1549	0.73	1/2088 (0.0%)
All	All	0.35	0/3108	0.73	1/4189 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	442	ILE	N-CA-C	-6.56	106.59	111.90

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	1526	0	1498	46	0
1	B	1516	0	1488	24	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
3	A	30	0	0	10	0
3	B	44	0	0	0	0
All	All	3120	0	2986	68	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 11.

All (68) 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:497:TYR:HB3	1:A:501:GLU:HG3	1.40	1.02
1:A:469:ARG:HG2	3:A:80:HOH:O	1.65	0.96
1:A:475:PHE:O	1:A:479:VAL:HG12	1.91	0.71
1:B:508:HIS:HE1	1:B:558:ILE:H	1.38	0.71
1:B:521:SER:HB3	1:B:527:TYR:CE2	2.26	0.70
1:A:564:ARG:HB3	3:A:93:HOH:O	1.92	0.70
1:A:438:ILE:HA	1:A:596:ARG:HD2	1.74	0.68
1:A:601:PRO:HA	3:A:80:HOH:O	1.95	0.65
1:A:522:PHE:HE2	1:A:528:ILE:HB	1.62	0.64
1:A:486:VAL:CG1	1:A:531:CYS:HB2	2.26	0.64
1:A:538:LYS:HA	1:A:541:GLU:OE2	1.98	0.63
1:A:486:VAL:HG12	1:A:531:CYS:HB2	1.81	0.62
1:A:510:GLN:HA	1:A:513:GLU:HB2	1.82	0.62
1:A:546:GLU:O	1:A:550:GLN:HG2	2.00	0.61
1:A:522:PHE:CE2	1:A:528:ILE:HB	2.37	0.60
1:A:484:PRO:HB2	3:A:81:HOH:O	2.03	0.59
1:A:521:SER:HB3	1:A:527:TYR:CE2	2.38	0.58
1:A:493:LEU:O	1:A:528:ILE:HA	2.04	0.57
1:A:588:ILE:O	1:A:592:LEU:HG	2.05	0.56
1:B:497:TYR:HB3	1:B:501:GLU:HB2	1.87	0.56
1:A:515:VAL:HG12	1:A:548:ILE:HD13	1.91	0.53
1:A:513:GLU:HA	3:A:95:HOH:O	2.07	0.53
1:A:498:SER:H	1:A:501:GLU:CG	2.22	0.53
1:B:473:GLU:HG3	1:B:598:THR:HB	1.91	0.53
1:A:596:ARG:HD3	3:A:55:HOH:O	2.10	0.52
1:A:554:ASP:HB3	3:A:87:HOH:O	2.11	0.51
1:A:498:SER:H	1:A:501:GLU:HG3	1.75	0.51
1:A:508:HIS:CA	1:A:511:GLU:HG3	2.41	0.51
1:B:584:ARG:HG3	1:B:587:GLU:OE1	2.11	0.50
1:A:517:VAL:HG13	1:A:545:ILE:HG23	1.94	0.50
1:A:495:PHE:HB3	1:A:497:TYR:CZ	2.47	0.49
1:B:504:ILE:O	1:B:508:HIS:HD2	1.94	0.49
1:B:464:HIS:HA	1:B:467:GLN:HE21	1.78	0.49
1:B:591:LEU:C	1:B:591:LEU:HD23	2.36	0.49
1:A:618:GLU:O	1:A:622:MET:HG3	2.14	0.48
1:A:510:GLN:CA	1:A:513:GLU:HB2	2.43	0.48
1:A:622:MET:HE3	1:B:612:ILE:HG13	1.96	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:529:VAL:HG11	1:B:545:ILE:HD13	1.96	0.48
1:A:508:HIS:HA	1:A:511:GLU:HG3	1.95	0.47
1:A:540:GLU:HG3	1:A:574:LYS:HG2	1.97	0.47
1:B:490:ILE:O	1:B:492:PRO:HD3	2.16	0.46
1:B:436:VAL:HG13	1:B:596:ARG:HG3	1.98	0.46
1:B:451:LEU:HD12	1:B:451:LEU:N	2.31	0.46
1:A:501:GLU:H	1:A:501:GLU:HG2	1.55	0.45
1:B:511:GLU:HG3	1:B:560:ILE:HG12	1.98	0.45
1:A:560:ILE:HG23	1:A:564:ARG:HG3	1.98	0.45
1:B:519:LEU:HD23	1:B:529:VAL:HG22	1.98	0.45
1:A:560:ILE:HG22	1:A:561:LYS:N	2.32	0.45
1:A:479:VAL:HG23	1:A:515:VAL:HA	1.97	0.45
1:B:464:HIS:HA	1:B:467:GLN:NE2	2.32	0.45
1:A:502:ALA:HA	3:A:90:HOH:O	2.16	0.44
1:B:621:LYS:HE3	1:B:621:LYS:HB3	1.78	0.44
1:A:509:LYS:NZ	1:A:527:TYR:HE2	2.15	0.44
1:B:441:PRO:HG3	1:B:592:LEU:HD12	2.00	0.44
1:A:567:ALA:O	1:A:571:MET:HG3	2.17	0.44
1:A:510:GLN:C	1:A:513:GLU:HB2	2.43	0.43
1:B:508:HIS:CE1	1:B:558:ILE:H	2.27	0.43
1:A:600:ASP:C	3:A:80:HOH:O	2.61	0.43
1:B:509:LYS:O	1:B:513:GLU:HG3	2.18	0.43
1:A:506:GLU:OE1	1:A:509:LYS:HD2	2.19	0.42
1:B:497:TYR:O	1:B:525:ASN:HB3	2.20	0.42
1:A:619:MET:HE1	1:B:445:MET:CE	2.49	0.41
1:A:527:TYR:HE1	3:A:90:HOH:O	2.04	0.41
1:A:600:ASP:OD2	1:A:603:THR:HB	2.21	0.41
1:A:501:GLU:O	1:A:505:ILE:HG13	2.21	0.41
1:B:541:GLU:H	1:B:541:GLU:CD	2.29	0.41
1:B:497:TYR:HB3	1:B:501:GLU:CB	2.50	0.40
1:A:508:HIS:HB3	1:A:511:GLU:HG3	2.04	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	182/197 (92%)	173 (95%)	8 (4%)	1 (0%)	24	24
1	B	181/197 (92%)	175 (97%)	6 (3%)	0	100	100
All	All	363/394 (92%)	348 (96%)	14 (4%)	1 (0%)	36	40

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	537	PRO

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	169/176 (96%)	150 (89%)	19 (11%)	6	4
1	B	168/176 (96%)	162 (96%)	6 (4%)	31	39
All	All	337/352 (96%)	312 (93%)	25 (7%)	13	11

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	487	GLN
1	A	498	SER
1	A	499	THR
1	A	500	ASN
1	A	501	GLU
1	A	503	LEU
1	A	509	LYS
1	A	510	GLN
1	A	511	GLU
1	A	512	LEU
1	A	524	SER
1	A	540	GLU

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Mol	Chain	Res	Type
1	A	546	GLU
1	A	553	LEU
1	A	558	ILE
1	A	560	ILE
1	A	561	LYS
1	A	562	LYS
1	A	574	LYS
1	B	436	VAL
1	B	507	GLN
1	B	530	ARG
1	B	540	GLU
1	B	565	GLU
1	B	566	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	456	ASN
1	A	507	GLN
1	A	550	GLN
1	A	606	HIS
1	B	446	HIS
1	B	463	GLN
1	B	467	GLN
1	B	508	HIS
1	B	557	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 4 ligands modelled in this entry, 4 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

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

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	186/197 (94%)	0.97	44 (23%) 2 1	23, 76, 148, 178	0
1	B	184/197 (93%)	0.16	6 (3%) 49 49	22, 43, 80, 131	1 (0%)
All	All	370/394 (93%)	0.57	50 (13%) 7 6	22, 52, 141, 178	1 (0%)

All (50) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	522	PHE	6.8
1	B	522	PHE	6.3
1	A	491	VAL	4.5
1	A	558	ILE	4.4
1	A	482	VAL	4.2
1	A	492	PRO	3.6
1	A	433	MET	3.6
1	A	505	ILE	3.4
1	A	530	ARG	3.4
1	A	515	VAL	3.3
1	A	573	CYS	3.3
1	A	497	TYR	3.3
1	A	493	LEU	3.2
1	A	516	GLY	3.1
1	B	490	ILE	3.0
1	A	490	ILE	2.9
1	A	501	GLU	2.9
1	A	553	LEU	2.8
1	A	528	ILE	2.8
1	A	563	LEU	2.8
1	A	518	PHE	2.8
1	B	573[A]	CYS	2.8
1	A	489	MET	2.7
1	A	508	HIS	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	582	HIS	2.5
1	B	624	LYS	2.4
1	A	507	GLN	2.4
1	A	488	GLU	2.4
1	A	534	ALA	2.4
1	A	523	GLY	2.4
1	A	511	GLU	2.4
1	A	556	LYS	2.3
1	B	435	ARG	2.3
1	A	531	CYS	2.3
1	A	486	VAL	2.3
1	A	502	ALA	2.2
1	A	557	ASN	2.2
1	A	524	SER	2.2
1	A	436	VAL	2.2
1	A	565	GLU	2.2
1	A	536	PHE	2.1
1	A	544	LEU	2.1
1	A	498	SER	2.1
1	A	561	LYS	2.1
1	A	485	GLU	2.1
1	A	484	PRO	2.1
1	A	514	SER	2.0
1	A	434	ASP	2.0
1	A	479	VAL	2.0
1	A	494	THR	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	ZN	A	2	1/1	0.91	0.14	78,78,78,78	1
2	ZN	B	4	1/1	0.96	0.12	76,76,76,76	1
2	ZN	A	1	1/1	0.98	0.12	63,63,63,63	0
2	ZN	B	3	1/1	0.99	0.09	52,52,52,52	1

6.5 Other polymers [i](#)

There are no such residues in this entry.