



Full wwPDB X-ray Structure Validation Report ⓘ

Jun 12, 2024 – 02:46 AM EDT

PDB ID : 2QPO
Title : Thermotoga Maritima Thymidine Kinase in the apo form
Authors : Segura-Pena, D.; Lichter, J.; Trani, M.; Konrad, M.; Lavie, A.; Lutz, S.
Deposited on : 2007-07-24
Resolution : 1.95 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 : 4.02b-467
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 1.20.1
EDS : 2.36.2
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36.2

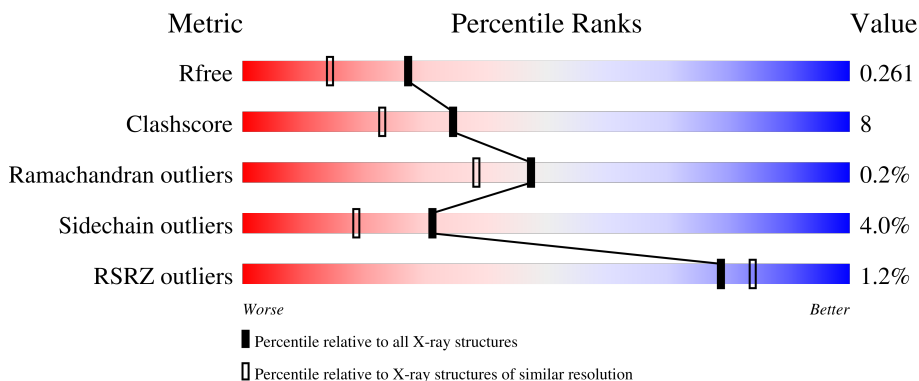
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.95 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}	130704	2580 (1.96-1.96)
Clashscore	141614	2705 (1.96-1.96)
Ramachandran outliers	138981	2678 (1.96-1.96)
Sidechain outliers	138945	2678 (1.96-1.96)
RSRZ outliers	127900	2539 (1.96-1.96)

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	184	 71% 10% 17%
1	B	184	 2% 68% 12% 18%
1	C	184	 % 66% 13% 20%
1	D	184	 % 66% 13% 18%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4910 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 Thymidine kinase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	153	1205	774	198	226	7	0	0	0
1	B	150	1174	755	193	219	7	0	0	0
1	C	148	1169	753	192	217	7	0	0	0
1	D	151	1183	763	195	218	7	0	0	0

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Zn	0	0
			1	1		
2	B	1	Total	Zn	0	0
			1	1		
2	C	1	Total	Zn	0	0
			1	1		
2	D	1	Total	Zn	0	0
			1	1		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	O	S	0	0
			5	4	1		
3	B	1	Total	O	S	0	0
			5	4	1		
3	C	1	Total	O	S	0	0
			5	4	1		
3	D	1	Total	O	S	0	0
			5	4	1		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	48	Total	O	0	0
			48	48		
4	B	37	Total	O	0	0
			37	37		
4	C	32	Total	O	0	0
			32	32		
4	D	38	Total	O	0	0
			38	38		

C140	H141	R142	C143	L152	K153	VAL	ALA	GLY	GLY	GLY	GLU	GLU	GLU	ILE	ASP	VAL	GLY	GLY	GLN	GLU	K168	Y169	I170	R174	Y177	K181	LYS	ARG	VAL
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4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	52.60Å 113.50Å 54.80Å 90.00° 109.16° 90.00°	Depositor
Resolution (Å)	28.61 – 1.95 28.61 – 1.95	Depositor EDS
% Data completeness (in resolution range)	98.3 (28.61-1.95) 98.3 (28.61-1.95)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.86 (at 1.95Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.203 , 0.261 0.205 , 0.261	Depositor DCC
R_{free} test set	4333 reflections (10.00%)	wwPDB-VP
Wilson B-factor (Å ²)	20.4	Xtrriage
Anisotropy	0.007	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 51.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.42$, $\langle L^2 \rangle = 0.24$	Xtrriage
Estimated twinning fraction	0.049 for l,-k,h	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	4910	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 23.13 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 4.9521e-03.*

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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, SO4

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	0.71	0/1224	0.80	3/1647 (0.2%)
1	B	0.67	0/1193	0.74	0/1608
1	C	0.69	0/1188	0.75	1/1600 (0.1%)
1	D	0.71	1/1202 (0.1%)	0.80	1/1620 (0.1%)
All	All	0.69	1/4807 (0.0%)	0.77	5/6475 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	143	CYS	CB-SG	-7.35	1.69	1.82

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	20	LEU	CA-CB-CG	7.65	132.91	115.30
1	A	116	LYS	CD-CE-NZ	5.99	125.47	111.70
1	C	21	LEU	CA-CB-CG	5.83	128.72	115.30
1	A	129	LEU	CA-CB-CG	5.19	127.23	115.30
1	D	78	ARG	NE-CZ-NH1	5.17	122.89	120.30

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	1205	0	1222	17	0
1	B	1174	0	1179	26	0
1	C	1169	0	1187	15	0
1	D	1183	0	1200	34	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	5	0	0	0	0
3	B	5	0	0	1	0
3	C	5	0	0	1	0
3	D	5	0	0	1	0
4	A	48	0	0	2	0
4	B	37	0	0	1	0
4	C	32	0	0	1	0
4	D	38	0	0	2	0
All	All	4910	0	4788	79	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 8.

All (79) 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:B:33:LYS:H	1:B:33:LYS:HD2	1.17	1.05
1:D:78:ARG:HG2	4:D:325:HOH:O	1.62	0.99
1:D:140:CYS:HB3	1:D:143:CYS:HB3	1.49	0.93
1:B:33:LYS:H	1:B:33:LYS:CD	1.83	0.90
1:B:32:LYS:NZ	1:B:78:ARG:HE	1.71	0.88
1:B:33:LYS:HD2	1:B:33:LYS:N	1.90	0.86
1:D:9:THR:HG21	1:D:112:ASP:HB3	1.57	0.84
1:A:146:TYR:CE1	1:D:26:ILE:HD11	2.15	0.81
1:B:32:LYS:HZ1	1:B:78:ARG:HE	1.28	0.81
1:A:115:HIS:HD2	4:A:313:HOH:O	1.72	0.72
1:D:117:GLN:HE22	1:D:174:ARG:HH12	1.40	0.69
1:D:78:ARG:HG2	1:D:78:ARG:HH11	1.58	0.69
1:D:140:CYS:CB	1:D:143:CYS:HB3	2.23	0.68
1:A:146:TYR:HE1	1:D:26:ILE:CD1	2.07	0.68
1:B:117:GLN:HE22	1:B:174:ARG:HH21	1.39	0.68
1:A:17:THR:HG22	1:A:83:ASP:OD2	1.93	0.67
1:A:117:GLN:HE22	1:A:174:ARG:HH12	1.43	0.67
1:A:25:GLU:OE1	1:D:18:THR:HG21	1.95	0.67

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:146:TYR:CE1	1:D:26:ILE:CD1	2.78	0.65
1:B:32:LYS:HZ1	1:B:78:ARG:NE	1.96	0.63
1:D:78:ARG:HH11	1:D:78:ARG:CG	2.12	0.63
1:B:97:LYS:HD2	1:D:117:GLN:NE2	2.14	0.62
1:D:152:LEU:HB3	1:D:170:ILE:HG22	1.81	0.62
1:B:117:GLN:NE2	1:B:174:ARG:HH21	1.97	0.62
1:D:9:THR:CG2	1:D:112:ASP:HB3	2.28	0.62
1:C:102:ARG:NH1	4:C:335:HOH:O	2.29	0.61
1:C:59:GLU:O	1:C:59:GLU:HG2	2.02	0.60
1:B:78:ARG:HG2	4:B:332:HOH:O	2.02	0.59
1:D:141:HIS:CG	1:D:170:ILE:HG12	2.38	0.58
1:B:25:GLU:O	1:B:29:LEU:HG	2.04	0.58
1:C:153:LYS:O	1:C:154:VAL:HG22	2.04	0.58
1:A:37:PHE:CD2	1:A:69:MET:HE3	2.40	0.56
1:D:22:SER:O	1:D:26:ILE:HG23	2.05	0.56
1:C:33:LYS:HD3	1:C:76:ASP:HB3	1.88	0.56
1:D:9:THR:HG23	1:D:110:GLY:O	2.05	0.55
1:D:9:THR:HG21	1:D:112:ASP:CB	2.35	0.55
1:B:21:LEU:O	1:B:25:GLU:HG3	2.06	0.55
1:C:175:ASP:O	1:C:179:THR:HG23	2.08	0.54
1:C:19:GLU:O	1:C:22:SER:HB3	2.07	0.54
1:B:5:LEU:HD23	1:B:130:ALA:HA	1.89	0.53
1:B:119:PRO:HG2	1:D:125:LEU:HD22	1.91	0.53
1:A:146:TYR:CD1	1:D:26:ILE:HD11	2.44	0.52
1:C:98:ASP:OD2	1:C:102:ARG:CZ	2.58	0.52
1:C:114:THR:HG23	1:C:118:ASN:O	2.10	0.52
1:B:32:LYS:HZ2	1:B:78:ARG:HE	1.53	0.52
1:B:117:GLN:NE2	1:D:97:LYS:HD2	2.27	0.49
1:C:17:THR:HG23	3:C:303:SO4:O4	2.11	0.49
1:B:85:VAL:HG11	1:B:108:CYS:HB3	1.96	0.48
1:D:38:LYS:HG2	1:D:62:VAL:HG22	1.95	0.48
1:B:175:ASP:OD1	1:D:2:SER:HB3	2.14	0.47
1:D:16:LYS:HE3	3:D:304:SO4:O3	2.15	0.47
1:B:117:GLN:NE2	1:B:174:ARG:NH2	2.62	0.45
1:D:26:ILE:HG13	1:D:27:TYR:N	2.31	0.45
1:A:37:PHE:CD2	1:A:69:MET:CE	3.00	0.45
1:A:137:LYS:HD2	1:A:147:ASN:HA	1.99	0.45
1:D:94:GLU:HG2	4:D:323:HOH:O	2.16	0.44
1:D:152:LEU:HD13	1:D:177:TYR:CE1	2.53	0.44
1:A:146:TYR:HE1	1:D:26:ILE:HD13	1.78	0.44
1:A:62:VAL:O	1:A:62:VAL:HG23	2.17	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:121:GLU:O	1:B:125:LEU:HG	2.18	0.43
1:A:78:ARG:HA	1:A:78:ARG:HD2	1.81	0.42
1:B:16:LYS:NZ	3:B:302:SO4:O3	2.42	0.42
1:B:38:LYS:HG2	1:B:39:PRO:HD2	2.00	0.42
1:A:115:HIS:CD2	4:A:313:HOH:O	2.57	0.42
1:B:85:VAL:HG22	1:B:110:GLY:HA3	2.01	0.41
1:C:85:VAL:HA	1:C:88:PHE:HD2	1.85	0.41
1:D:9:THR:CG2	1:D:112:ASP:CB	2.97	0.41
1:B:26:ILE:HG21	1:C:146:TYR:HE1	1.85	0.41
1:C:5:LEU:HD23	1:C:130:ALA:HA	2.01	0.41
1:A:17:THR:O	1:A:21:LEU:HG	2.21	0.41
1:B:125:LEU:HD22	1:D:119:PRO:HG2	2.03	0.41
1:C:89:ASN:H	1:C:89:ASN:ND2	2.19	0.41
1:B:78:ARG:NH2	1:C:145:GLU:OE2	2.53	0.41
1:D:121:GLU:O	1:D:125:LEU:HG	2.20	0.41
1:D:78:ARG:HG2	1:D:78:ARG:NH1	2.32	0.41
1:D:98:ASP:O	1:D:102:ARG:HG3	2.21	0.41
1:C:4:LYS:HE2	1:C:4:LYS:HB2	1.83	0.41
1:A:19:GLU:O	1:A:22:SER:HB3	2.21	0.40
1:D:32:LYS:HE3	1:D:78:ARG:HD3	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	147/184 (80%)	144 (98%)	2 (1%)	1 (1%)	22	11
1	B	144/184 (78%)	143 (99%)	1 (1%)	0	100	100
1	C	142/184 (77%)	140 (99%)	2 (1%)	0	100	100
1	D	145/184 (79%)	143 (99%)	2 (1%)	0	100	100
All	All	578/736 (78%)	570 (99%)	7 (1%)	1 (0%)	47	38

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	147	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	A	133/161 (83%)	126 (95%)	7 (5%)	22	10
1	B	129/161 (80%)	125 (97%)	4 (3%)	40	28
1	C	130/161 (81%)	125 (96%)	5 (4%)	33	21
1	D	130/161 (81%)	125 (96%)	5 (4%)	33	21
All	All	522/644 (81%)	501 (96%)	21 (4%)	31	19

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	20	LEU
1	A	70	ARG
1	A	74	GLU
1	A	78	ARG
1	A	85	VAL
1	A	125	LEU
1	A	129	LEU
1	B	33	LYS
1	B	38	LYS
1	B	94	GLU
1	B	116	LYS
1	C	21	LEU
1	C	67	GLU
1	C	95	VAL
1	C	170	ILE
1	C	179	THR
1	D	22	SER
1	D	26	ILE
1	D	78	ARG

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Mol	Chain	Res	Type
1	D	153	LYS
1	D	170	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	115	HIS
1	A	117	GLN
1	B	61	HIS
1	B	117	GLN
1	C	89	ASN
1	C	115	HIS
1	D	117	GLN
1	D	141	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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 4 are monoatomic - leaving 4 for Mogul analysis.

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
3	SO4	B	302	-	4,4,4	0.31	0	6,6,6	0.33	0
3	SO4	D	304	-	4,4,4	0.43	0	6,6,6	0.22	0
3	SO4	C	303	-	4,4,4	0.32	0	6,6,6	0.64	0
3	SO4	A	301	-	4,4,4	0.23	0	6,6,6	0.49	0

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.

3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	302	SO4	1	0
3	D	304	SO4	1	0
3	C	303	SO4	1	0

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	153/184 (83%)	-0.13	0 100 100	11, 20, 35, 41	0
1	B	150/184 (81%)	0.00	3 (2%) 65 73	12, 23, 37, 43	0
1	C	148/184 (80%)	-0.11	2 (1%) 75 82	11, 20, 32, 35	0
1	D	151/184 (82%)	-0.08	2 (1%) 77 83	12, 21, 32, 44	0
All	All	602/736 (81%)	-0.08	7 (1%) 79 84	11, 21, 35, 44	0

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	154	VAL	2.6
1	C	170	ILE	2.4
1	D	170	ILE	2.3
1	B	70	ARG	2.2
1	B	13	TYR	2.2
1	C	154	VAL	2.1
1	D	58	VAL	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 monosaccharides 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(Å ²)	Q<0.9
3	SO4	B	302	5/5	0.98	0.10	29,30,32,33	0
3	SO4	A	301	5/5	0.99	0.09	25,25,25,27	0
2	ZN	B	202	1/1	0.99	0.05	24,24,24,24	0
3	SO4	C	303	5/5	0.99	0.06	18,19,20,21	0
3	SO4	D	304	5/5	0.99	0.07	16,23,23,24	0
2	ZN	C	204	1/1	1.00	0.06	20,20,20,20	0
2	ZN	D	203	1/1	1.00	0.04	24,24,24,24	0
2	ZN	A	201	1/1	1.00	0.05	19,19,19,19	0

6.5 Other polymers [i](#)

There are no such residues in this entry.