



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 10, 2026 – 03:32 AM UTC

PDB ID : 4E8K / pdb\_00004e8k  
Title : Structure of *Oceanobacillus iheyensis* group II intron in the presence of K<sup>+</sup>, Ca<sup>2+</sup> and a non-hydrolyzed oligonucleotide substrate  
Authors : Marcia, M.; Pyle, A.M.  
Deposited on : 2012-03-20  
Resolution : 3.03 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  
Mogul : 2022.3.0, CSD as543be (2022)  
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

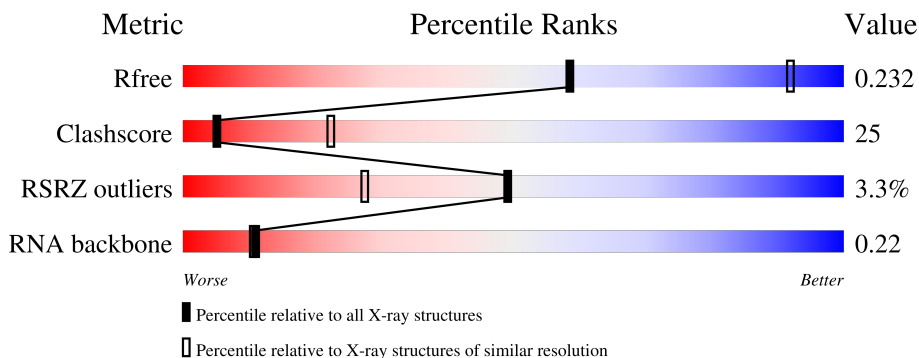
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.03 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	3685 (3.08-3.00)
Clashscore	190562	4007 (3.08-3.00)
RSRZ outliers	180081	3684 (3.08-3.00)
RNA backbone	3983	1163 (3.28-2.80)

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	A	393	
2	B	10	

## 2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 8625 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 RNA chain called Group IIC intron.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	A	388	8326	3715	1547	2676	388	0	0	0

- Molecule 2 is a RNA chain called 5'-R>(\*CP\*G\*AP\*UP\*UP\*UP\*AP\*UP\*UP\*A)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	B	7	141	65	20	50	6	0	0	0

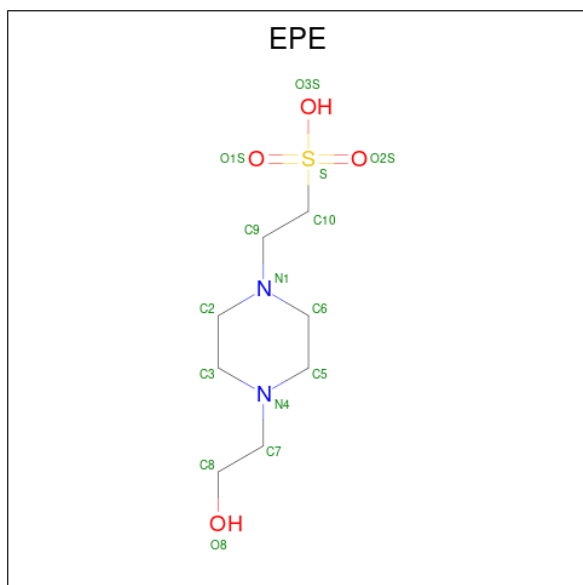
- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	24	Total	Ca	0	0
			24	24		
3	B	2	Total	Ca	0	0
			2	2		

- Molecule 4 is POTASSIUM ION (CCD ID: K) (formula: K).

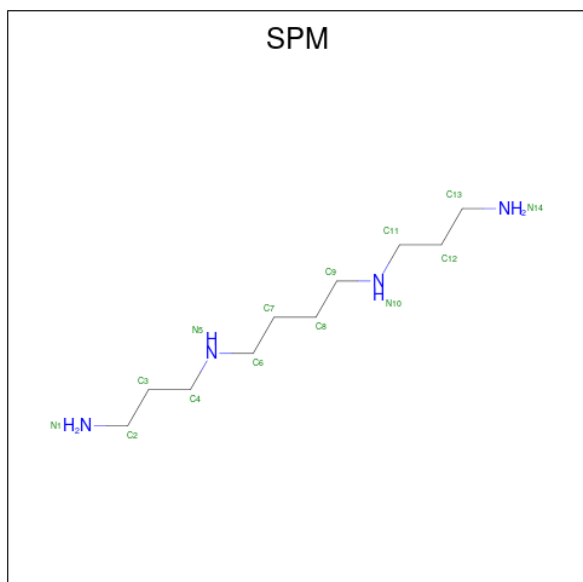
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	18	Total	K	0	0
			18	18		

- Molecule 5 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (CCD ID: EPE) (formula: C<sub>8</sub>H<sub>18</sub>N<sub>2</sub>O<sub>4</sub>S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
5	A	1	Total	C	N	O	S	0	0
			15	8	2	4	1		
5	A	1	Total	C	N	O	S	0	0
			15	8	2	4	1		
5	A	1	Total	C	N	O	S	0	0
			15	8	2	4	1		
5	A	1	Total	C	N	O	S	0	0
			15	8	2	4	1		
5	A	1	Total	C	O	S		0	0
			5	1	3	1			

- Molecule 6 is SPERMINE (CCD ID: SPM) (formula:  $C_{10}H_{26}N_4$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	C	N	0	0
			14	10	4		

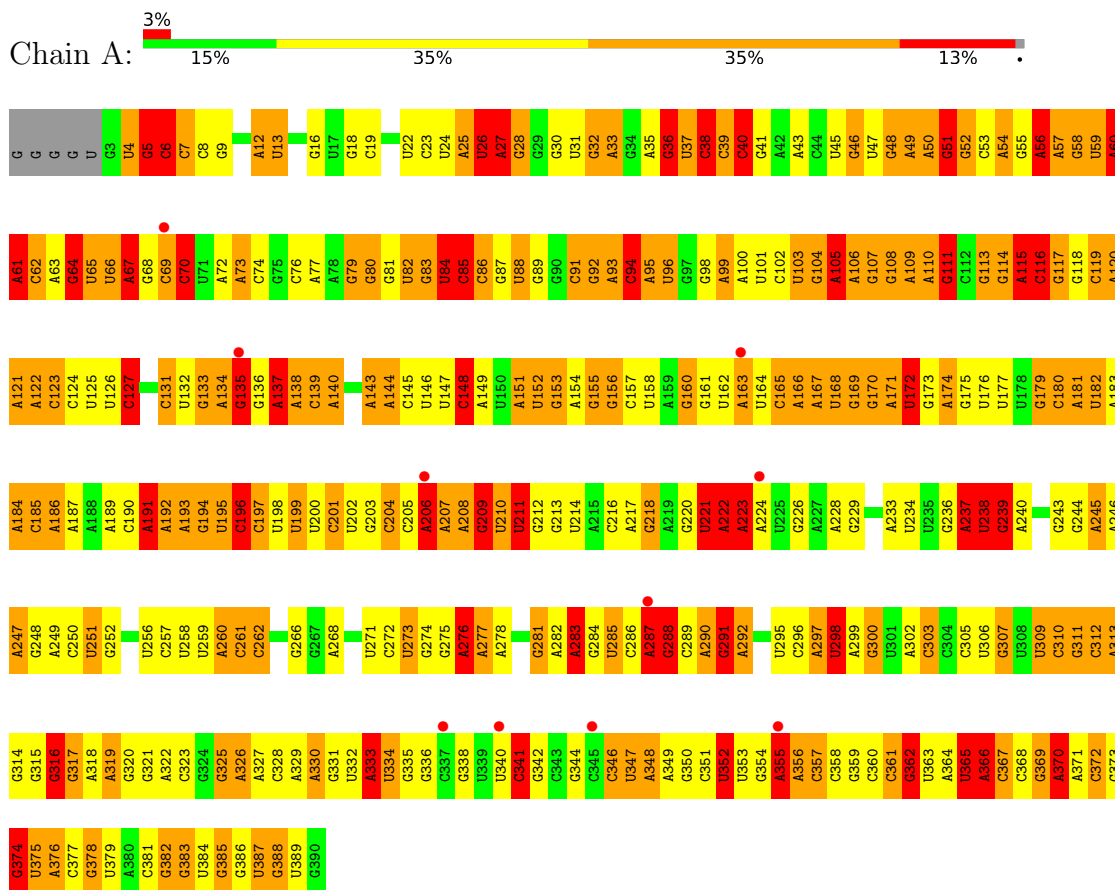
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	33	Total	O	0	0
			33	33		
7	B	2	Total	O	0	0
			2	2		

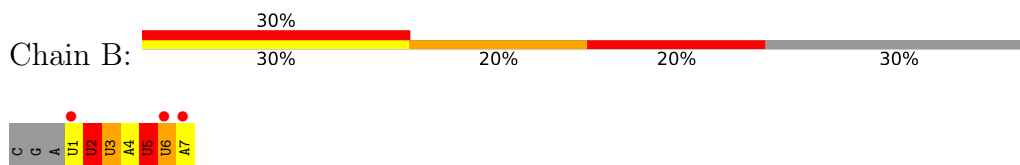
### 3 Residue-property plots [i](#)

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: Group IIC intron



- Molecule 2: 5'-R>(\*CP\*G\*AP\*UP\*UP\*UP\*UP\*AP\*UP\*UP\*A)-3'



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	88.45Å 96.25Å 224.35Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.11 – 3.03 49.11 – 3.03	Depositor EDS
% Data completeness (in resolution range)	90.3 (49.11-3.03) 90.3 (49.11-3.03)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.60 (at 3.01Å)	Xtrriage
Refinement program	REFMAC 5.6.0117	Depositor
R, $R_{free}$	0.195 , 0.235 (Not available) , 0.232	Depositor DCC
$R_{free}$ test set	1731 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	86.5	Xtrriage
Anisotropy	0.524	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.27 , 90.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	8625	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	103.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.09% 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: EPE, SPM, CA, K

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	0.55	1/9331 (0.0%)	1.52	261/14556 (1.8%)
2	B	0.74	0/156	1.82	7/240 (2.9%)
All	All	0.55	1/9487 (0.0%)	1.53	268/14796 (1.8%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	99	A	O3'-P	6.12	1.70	1.61

The worst 5 of 268 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	55	G	O3'-P-O5'	-14.07	82.90	104.00
1	A	58	G	O3'-P-O5'	-13.95	83.07	104.00
1	A	168	U	C2'-C3'-O3'	13.62	129.92	109.50
1	A	95	A	O3'-P-O5'	13.53	124.29	104.00
1	A	91	C	O3'-P-O5'	-13.48	83.78	104.00

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	8326	0	4178	297	0
2	B	141	0	74	9	0
3	A	24	0	0	0	0
3	B	2	0	0	0	0
4	A	18	0	0	0	0
5	A	65	0	73	12	0
6	A	14	0	26	1	0
7	A	33	0	0	2	0
7	B	2	0	0	0	0
All	All	8625	0	4351	304	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 25.

The worst 5 of 304 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:287:A:H4'	1:A:288:G:OP1	1.32	1.11
1:A:388:G:O2'	1:A:389:U:C5	2.10	1.05
1:A:238:U:H6	1:A:238:U:H5'	1.23	1.03
1:A:387:U:H2'	1:A:388:G:H5'	1.35	1.03
1:A:287:A:H5'	7:A:909:HOH:O	1.57	1.02

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

There are no protein molecules in this entry.

### 5.3.2 Protein sidechains [i](#)

There are no protein molecules in this entry.

### 5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	A	386/393 (98%)	146 (37%)	33 (8%)

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Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	B	6/10 (60%)	5 (83%)	1 (16%)
All	All	392/403 (97%)	151 (38%)	34 (8%)

5 of 151 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	A	5	G
1	A	6	C
1	A	12	A
1	A	13	U
1	A	16	G

5 of 34 RNA pucker outliers are listed below:

Mol	Chain	Res	Type
1	A	334	U
1	A	341	C
1	A	388	G
1	A	206	A
1	A	174	A

## 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 50 ligands modelled in this entry, 44 are monoatomic - leaving 6 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
5	EPE	A	448	-	4,4,15	1.63	1 (25%)	6,6,20	0.68	0
5	EPE	A	443	-	15,15,15	2.16	2 (13%)	19,20,20	1.37	3 (15%)
5	EPE	A	447	4	15,15,15	2.27	2 (13%)	19,20,20	1.99	7 (36%)
6	SPM	A	445	-	13,13,13	0.39	0	12,12,12	0.92	1 (8%)
5	EPE	A	446	-	15,15,15	2.30	2 (13%)	19,20,20	1.48	3 (15%)
5	EPE	A	441	-	15,15,15	2.44	2 (13%)	19,20,20	1.41	4 (21%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	EPE	A	443	-	-	5/9/19/19	0/1/1/1
5	EPE	A	447	4	-	6/9/19/19	0/1/1/1
6	SPM	A	445	-	-	9/11/11/11	-
5	EPE	A	446	-	-	4/9/19/19	0/1/1/1
5	EPE	A	441	-	-	3/9/19/19	0/1/1/1

The worst 5 of 9 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	441	EPE	C10-S	-8.15	1.66	1.77
5	A	447	EPE	C10-S	-7.40	1.67	1.77
5	A	443	EPE	C10-S	-6.94	1.67	1.77
5	A	446	EPE	C10-S	-6.89	1.67	1.77
5	A	446	EPE	O3S-S	5.23	1.66	1.47

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	447	EPE	O3S-S-C10	4.65	115.09	106.00
5	A	446	EPE	O1S-S-C10	4.13	112.96	106.73
5	A	447	EPE	C5-N4-C3	3.29	115.93	108.84
5	A	446	EPE	O2S-S-O1S	-3.22	103.34	113.82
5	A	443	EPE	C5-C6-N1	-2.93	104.73	110.65

There are no chirality outliers.

5 of 27 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	441	EPE	C8-C7-N4-C5
5	A	443	EPE	S-C10-C9-N1
5	A	446	EPE	C8-C7-N4-C5
5	A	447	EPE	C9-C10-S-O1S
5	A	447	EPE	C9-C10-S-O3S

There are no ring outliers.

5 monomers are involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	448	EPE	3	0
5	A	443	EPE	3	0
5	A	447	EPE	5	0
6	A	445	SPM	1	0
5	A	446	EPE	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, 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	A	388/393 (98%)	-0.14	10 (2%) 57 33	53, 89, 193, 296	0
2	B	7/10 (70%)	1.51	3 (42%) 0 0	31, 72, 121, 124	2 (28%)
All	All	395/403 (98%)	-0.11	13 (3%) 49 27	31, 89, 193, 296	2 (0%)

The worst 5 of 13 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	6	U	4.2
1	A	287	A	3.1
2	B	1	U	3.0
1	A	163	A	2.9
1	A	355	A	2.9

### 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(Å <sup>2</sup> )	Q<0.9
4	K	A	444	1/1	0.76	0.27	137,137,137,137	0
5	EPE	A	448	5/15	0.76	0.30	69,77,84,87	5
4	K	A	432	1/1	0.79	0.10	119,119,119,119	0
4	K	A	438	1/1	0.83	0.26	131,131,131,131	0
3	CA	A	423	1/1	0.84	0.13	136,136,136,136	0
3	CA	A	415	1/1	0.86	0.25	105,105,105,105	0
3	CA	A	413	1/1	0.86	0.21	103,103,103,103	0
3	CA	A	407	1/1	0.87	0.12	114,114,114,114	0
3	CA	A	421	1/1	0.88	0.09	134,134,134,134	0
3	CA	A	414	1/1	0.88	0.14	126,126,126,126	0
3	CA	A	411	1/1	0.88	0.26	136,136,136,136	0
4	K	A	431	1/1	0.89	0.21	102,102,102,102	0
5	EPE	A	441	15/15	0.89	0.17	111,123,163,163	11
4	K	A	440	1/1	0.89	0.23	112,112,112,112	0
5	EPE	A	443	15/15	0.90	0.24	85,117,146,160	11
3	CA	A	405	1/1	0.91	0.16	105,105,105,105	0
3	CA	A	406	1/1	0.91	0.24	114,114,114,114	0
3	CA	A	422	1/1	0.91	0.09	98,98,98,98	0
3	CA	A	424	1/1	0.92	0.15	98,98,98,98	0
4	K	A	436	1/1	0.92	0.10	82,82,82,82	0
4	K	A	425	1/1	0.92	0.22	101,101,101,101	0
3	CA	A	412	1/1	0.92	0.24	146,146,146,146	0
6	SPM	A	445	14/14	0.92	0.24	67,76,88,94	14
4	K	A	442	1/1	0.93	0.12	103,103,103,103	0
5	EPE	A	447	15/15	0.93	0.15	53,77,87,88	15
3	CA	A	409	1/1	0.93	0.14	107,107,107,107	0
3	CA	A	404	1/1	0.93	0.20	111,111,111,111	0
4	K	A	428	1/1	0.94	0.27	130,130,130,130	0
3	CA	A	402	1/1	0.94	0.19	105,105,105,105	0
3	CA	A	416	1/1	0.94	0.37	118,118,118,118	0
4	K	A	435	1/1	0.94	0.24	98,98,98,98	0
3	CA	A	420	1/1	0.94	0.14	114,114,114,114	0
3	CA	A	401	1/1	0.94	0.06	110,110,110,110	0
4	K	A	427	1/1	0.94	0.09	115,115,115,115	0
3	CA	A	417	1/1	0.95	0.12	93,93,93,93	0
4	K	A	439	1/1	0.95	0.08	99,99,99,99	0
3	CA	A	408	1/1	0.95	0.18	89,89,89,89	0
3	CA	A	410	1/1	0.95	0.19	80,80,80,80	0
4	K	A	430	1/1	0.95	0.19	84,84,84,84	0
3	CA	A	403	1/1	0.96	0.09	95,95,95,95	0
4	K	A	437	1/1	0.96	0.32	98,98,98,98	0
4	K	A	434	1/1	0.96	0.15	66,66,66,66	0
3	CA	A	419	1/1	0.96	0.17	116,116,116,116	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	CA	A	418	1/1	0.97	0.05	116,116,116,116	0
4	K	A	426	1/1	0.97	0.09	85,85,85,85	0
5	EPE	A	446	15/15	0.97	0.14	54,92,95,101	11
3	CA	B	500	1/1	0.98	0.07	83,83,83,83	0
3	CA	B	501	1/1	0.98	0.07	73,73,73,73	0
4	K	A	429	1/1	0.98	0.10	87,87,87,87	0
4	K	A	433	1/1	0.99	0.03	74,74,74,74	0

## 6.5 Other polymers [\(i\)](#)

There are no such residues in this entry.