



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 4, 2024 – 01:19 pm BST

PDB ID : 8QA7  
Title : Crystal structure of HDAC6 catalytic domain 2 from zebrafish in complex with buffer component.  
Authors : Sandmark, J.; Ek, M.  
Deposited on : 2023-08-22  
Resolution : 1.47 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](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 : 4.02b-467  
Mogul : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.002 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.38.2

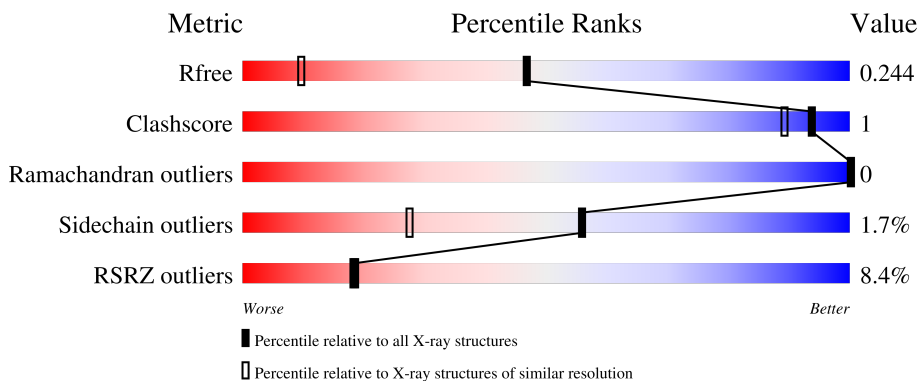
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

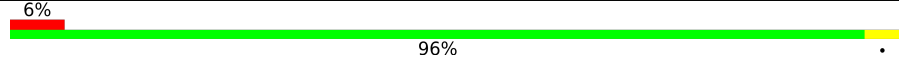
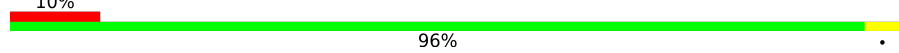
The reported resolution of this entry is 1.47 Å.

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))
$R_{free}$	164625	6131 (1.50-1.46)
Clashscore	180529	6623 (1.50-1.46)
Ramachandran outliers	177936	6521 (1.50-1.46)
Sidechain outliers	177891	6518 (1.50-1.46)
RSRZ outliers	164620	6132 (1.50-1.46)

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	358	 6% 96%
1	B	358	 10% 96%

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 5880 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 Histone deacetylase 6.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	357	2797	1761	498	520	18	0	4	0
1	B	358	2819	1777	503	521	18	0	5	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	441	ALA	-	expression tag	UNP F8W4B7
B	441	ALA	-	expression tag	UNP F8W4B7

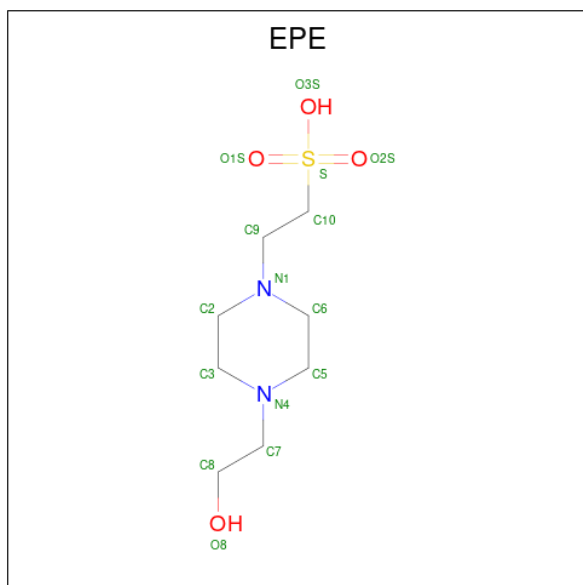
- Molecule 2 is POTASSIUM ION (three-letter code: K) (formula: K).

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

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total 1	Zn 1	0	0
3	B	1	Total 1	Zn 1	0	0

- Molecule 4 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (three-letter code: 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		
4	A	1	15	8	2	4	1	0	0
4	B	1	15	8	2	4	1	0	0

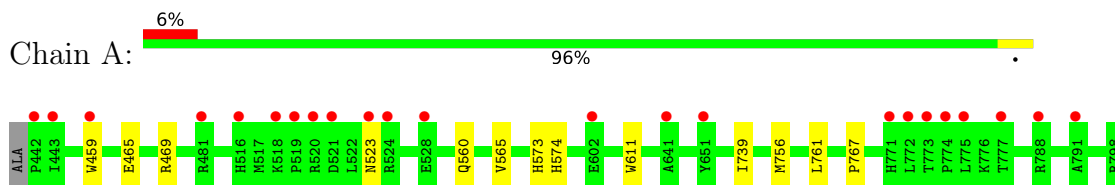
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	A	124	124	124	0	0
5	B	104	104	104	0	0

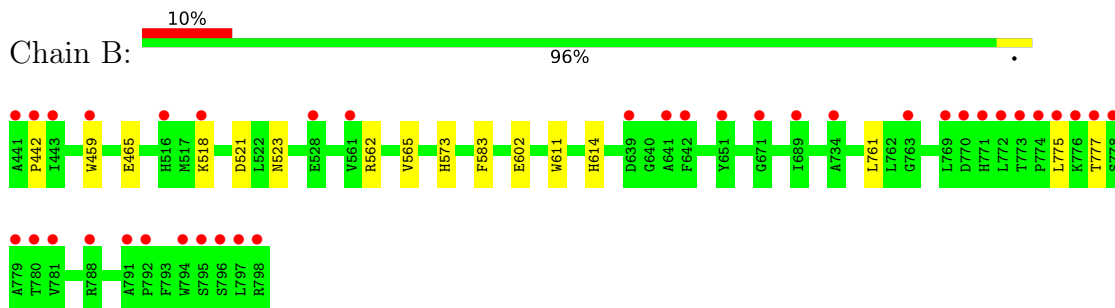
### 3 Residue-property plots [i](#)

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: Histone deacetylase 6



- Molecule 1: Histone deacetylase 6



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	75.39Å 92.37Å 96.19Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	66.63 – 1.47 66.63 – 1.47	Depositor EDS
% Data completeness (in resolution range)	99.1 (66.63-1.47) 99.1 (66.63-1.47)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.49 (at 1.47Å)	Xtrriage
Refinement program	REFMAC 5.8.0158	Depositor
R, $R_{free}$	0.217 , 0.240 0.223 , 0.244	Depositor DCC
$R_{free}$ test set	5676 reflections (4.95%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	19.3	Xtrriage
Anisotropy	0.312	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 34.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.000 for -h,l,k	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	5880	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	27.0	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 49.00 % 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 7.9385e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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, ZN, 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	0.43	0/2880	0.67	2/3907 (0.1%)
1	B	0.43	0/2907	0.67	0/3945
All	All	0.43	0/5787	0.67	2/7852 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	469	ARG	NE-CZ-NH1	5.88	123.24	120.30
1	A	469	ARG	NE-CZ-NH2	-5.28	117.66	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	2797	0	2721	6	0
1	B	2819	0	2746	8	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	15	0	17	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	15	0	17	3	0
5	A	124	0	0	0	0
5	B	104	0	0	2	0
All	All	5880	0	5501	15	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.

All (15) 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:583:PHE:CZ	4:B:804:EPE:H62	2.36	0.60
1:B:521:ASP:OD1	5:B:901:HOH:O	2.16	0.60
1:A:574:HIS:NE2	4:A:804:EPE:H101	2.17	0.58
1:B:583:PHE:CE2	4:B:804:EPE:H62	2.42	0.54
1:A:756:MET:CE	1:A:767:PRO:HG3	2.39	0.52
1:A:459:TRP:CZ2	1:A:523:ASN:HB2	2.46	0.51
1:B:614:HIS:CE1	4:B:804:EPE:H91	2.47	0.50
1:A:565[A]:VAL:HG13	1:A:761:LEU:HD12	1.95	0.48
1:B:565[A]:VAL:HG13	1:B:761:LEU:HD12	1.97	0.47
1:A:756:MET:HE1	1:A:767:PRO:HG3	1.97	0.47
1:B:442:PRO:HB3	1:B:562:ARG:HD3	2.00	0.44
1:B:518:LYS:HE2	5:B:922:HOH:O	2.17	0.43
4:A:804:EPE:H61	4:A:804:EPE:H102	1.96	0.41
1:B:459[A]:TRP:CZ2	1:B:523:ASN:HB2	2.56	0.41
1:A:565[A]:VAL:HG12	1:A:739:ILE:HB	2.02	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	359/358 (100%)	350 (98%)	9 (2%)	0	100	100
1	B	361/358 (101%)	352 (98%)	9 (2%)	0	100	100
All	All	720/716 (101%)	702 (98%)	18 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	304/301 (101%)	300 (99%)	4 (1%)	65	39
1	B	306/301 (102%)	300 (98%)	6 (2%)	50	20
All	All	610/602 (101%)	600 (98%)	10 (2%)	56	30

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	465	GLU
1	A	560	GLN
1	A	573	HIS
1	A	611	TRP
1	B	465	GLU
1	B	573	HIS
1	B	602	GLU
1	B	611	TRP
1	B	775	LEU
1	B	777	THR

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 8 ligands modelled in this entry, 6 are monoatomic - leaving 2 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
4	EPE	A	804	3	15,15,15	2.13	2 (13%)	18,20,20	2.39	10 (55%)
4	EPE	B	804	3	15,15,15	1.85	2 (13%)	18,20,20	1.57	4 (22%)

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
4	EPE	A	804	3	-	6/9/19/19	0/1/1/1
4	EPE	B	804	3	-	3/9/19/19	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	804	EPE	C10-S	-7.32	1.67	1.77
4	B	804	EPE	C10-S	-6.40	1.68	1.77
4	A	804	EPE	O1S-S	3.37	1.55	1.45
4	B	804	EPE	O2S-S	2.68	1.52	1.45

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	804	EPE	O1S-S-C10	6.57	114.82	106.92
4	B	804	EPE	O3S-S-C10	3.77	111.87	105.77
4	A	804	EPE	C2-C3-N4	3.03	116.85	110.64
4	B	804	EPE	O1S-S-C10	2.93	110.44	106.92
4	A	804	EPE	O3S-S-C10	-2.93	101.03	105.77
4	A	804	EPE	O2S-S-C10	2.66	110.12	106.92
4	A	804	EPE	C9-N1-C2	-2.44	105.00	111.23
4	A	804	EPE	C9-N1-C6	2.33	117.20	111.23
4	B	804	EPE	O2S-S-O1S	-2.31	105.97	113.95
4	A	804	EPE	C7-N4-C3	-2.28	105.42	111.23
4	B	804	EPE	O3S-S-O2S	-2.25	105.79	111.27
4	A	804	EPE	C5-N4-C3	2.18	113.73	108.83
4	A	804	EPE	C6-C5-N4	2.16	115.08	110.64
4	A	804	EPE	C3-C2-N1	2.10	114.94	110.64

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	804	EPE	C10-C9-N1-C6
4	A	804	EPE	S-C10-C9-N1
4	B	804	EPE	C9-C10-S-O1S
4	A	804	EPE	C9-C10-S-O3S
4	A	804	EPE	C9-C10-S-O1S
4	A	804	EPE	C9-C10-S-O2S
4	B	804	EPE	C9-C10-S-O2S
4	B	804	EPE	C9-C10-S-O3S
4	A	804	EPE	C10-C9-N1-C2

There are no ring outliers.

2 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	804	EPE	2	0
4	B	804	EPE	3	0

## 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

### 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, 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	357/358 (99%)	0.54	23 (6%) 27 28	11, 24, 41, 64	4 (1%)
1	B	358/358 (100%)	0.79	37 (10%) 13 12	12, 26, 43, 73	5 (1%)
All	All	715/716 (99%)	0.67	60 (8%) 18 18	11, 25, 41, 73	9 (1%)

All (60) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	772	LEU	6.8
1	B	459[A]	TRP	6.3
1	B	775	LEU	4.9
1	B	777	THR	4.7
1	B	441	ALA	4.7
1	A	459	TRP	4.5
1	B	773	THR	3.6
1	B	774	PRO	3.5
1	B	641	ALA	3.4
1	A	520	ARG	3.3
1	A	518	LYS	3.2
1	B	771	HIS	3.2
1	A	443	ILE	3.0
1	A	641	ALA	3.0
1	B	778	SER	3.0
1	A	788	ARG	3.0
1	A	772	LEU	3.0
1	B	781	VAL	3.0
1	B	651	TYR	2.9
1	A	771	HIS	2.9
1	B	769	LEU	2.9
1	B	795	SER	2.8
1	A	775	LEU	2.8
1	A	521	ASP	2.8

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Mol	Chain	Res	Type	RSRZ
1	B	797	LEU	2.7
1	A	516	HIS	2.7
1	B	763	GLY	2.7
1	B	779	ALA	2.7
1	A	777	THR	2.6
1	B	442	PRO	2.6
1	A	442	PRO	2.6
1	A	774	PRO	2.6
1	B	780	THR	2.5
1	B	770	ASP	2.5
1	B	791	ALA	2.5
1	B	518	LYS	2.5
1	B	792	PRO	2.5
1	A	519	PRO	2.5
1	B	671	GLY	2.4
1	B	776	LYS	2.4
1	A	791	ALA	2.3
1	A	528	GLU	2.3
1	B	443	ILE	2.3
1	B	528	GLU	2.3
1	B	639	ASP	2.3
1	A	523	ASN	2.2
1	B	798	ARG	2.2
1	B	561	VAL	2.2
1	B	734	ALA	2.2
1	B	788	ARG	2.1
1	B	794	TRP	2.1
1	A	524	ARG	2.1
1	A	773	THR	2.1
1	B	516	HIS	2.1
1	B	796	SER	2.1
1	B	642	PHE	2.1
1	A	602	GLU	2.1
1	A	481	ARG	2.0
1	A	651	TYR	2.0
1	B	689	ILE	2.0

## 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 [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, 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	EPE	A	804	15/15	0.67	0.20	26,29,31,33	0
4	EPE	B	804	15/15	0.78	0.17	26,29,30,31	0
2	K	A	802	1/1	0.95	0.44	42,42,42,42	0
2	K	B	802	1/1	0.96	0.44	41,41,41,41	0
2	K	B	801	1/1	0.99	0.11	23,23,23,23	0
3	ZN	B	803	1/1	0.99	0.18	28,28,28,28	0
3	ZN	A	803	1/1	1.00	0.18	28,28,28,28	0
2	K	A	801	1/1	1.00	0.06	21,21,21,21	0

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

There are no such residues in this entry.