



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 02:30 PM UTC

PDB ID : 1XRU / pdb_00001xru
Title : Crystal Structure of 5-keto-4-deoxyuronate Isomerase from Eschericia coli
Authors : Crowther, R.L.; Georgiadis, M.M.
Deposited on : 2004-10-15
Resolution : 1.94 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
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

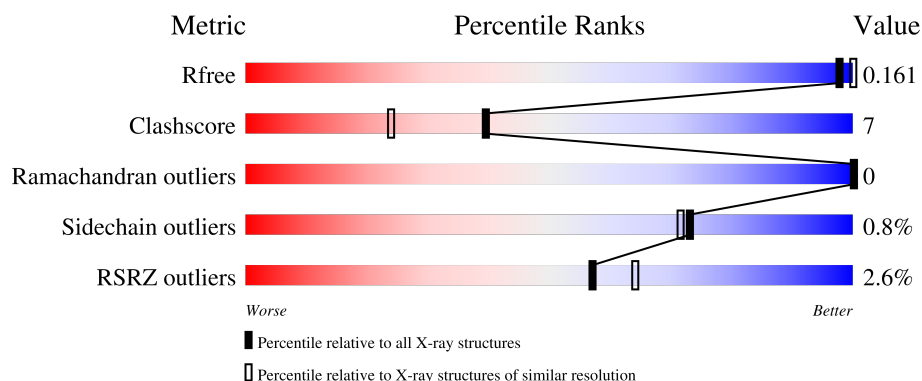
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.94 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	1452 (1.94-1.94)
Clashscore	190562	1494 (1.94-1.94)
Ramachandran outliers	187476	1479 (1.94-1.94)
Sidechain outliers	187428	1479 (1.94-1.94)
RSRZ outliers	180081	1453 (1.94-1.94)

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	282	2% 85% 15%
1	B	282	3% 83% 16%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 4890 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 4-deoxy-L-threo-5-hexosulose-uronate ketol-isomerase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	281	Total	C	N	O	S	Se	0	6	0
			2200	1391	374	416	8	11			
1	B	281	Total	C	N	O	S	Se	0	5	0
			2199	1387	373	420	8	11			

There are 36 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	cloning artifact	UNP Q46938
A	-1	SER	-	cloning artifact	UNP Q46938
A	0	ALA	-	cloning artifact	UNP Q46938
A	37	MSE	MET	modified residue	UNP Q46938
A	51	MSE	MET	modified residue	UNP Q46938
A	179	MSE	MET	modified residue	UNP Q46938
A	193	MSE	MET	modified residue	UNP Q46938
A	202	MSE	MET	modified residue	UNP Q46938
A	210	MSE	MET	modified residue	UNP Q46938
A	219	MSE	MET	modified residue	UNP Q46938
A	220	MSE	MET	modified residue	UNP Q46938
A	231	MSE	MET	modified residue	UNP Q46938
A	259	MSE	MET	modified residue	UNP Q46938
A	269	MSE	MET	modified residue	UNP Q46938
A	276	GLU	ASP	see remark 999	UNP Q46938
A	277	ILE	LEU	see remark 999	UNP Q46938
A	278	CYS	ARG	see remark 999	UNP Q46938
A	279	ALA	-	see remark 999	UNP Q46938
B	-2	GLY	-	cloning artifact	UNP Q46938
B	-1	SER	-	cloning artifact	UNP Q46938
B	0	ALA	-	cloning artifact	UNP Q46938
B	37	MSE	MET	modified residue	UNP Q46938
B	51	MSE	MET	modified residue	UNP Q46938
B	179	MSE	MET	modified residue	UNP Q46938
B	193	MSE	MET	modified residue	UNP Q46938

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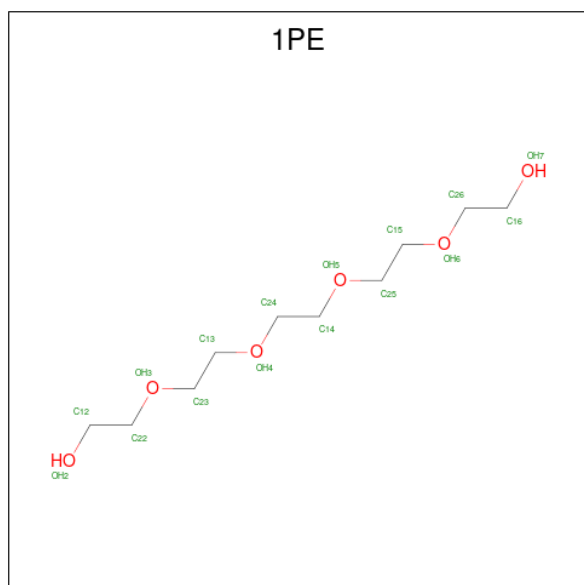
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Chain	Residue	Modelled	Actual	Comment	Reference
B	202	MSE	MET	modified residue	UNP Q46938
B	210	MSE	MET	modified residue	UNP Q46938
B	219	MSE	MET	modified residue	UNP Q46938
B	220	MSE	MET	modified residue	UNP Q46938
B	231	MSE	MET	modified residue	UNP Q46938
B	259	MSE	MET	modified residue	UNP Q46938
B	269	MSE	MET	modified residue	UNP Q46938
B	276	GLU	ASP	see remark 999	UNP Q46938
B	277	ILE	LEU	see remark 999	UNP Q46938
B	278	CYS	ARG	see remark 999	UNP Q46938
B	279	ALA	-	see remark 999	UNP Q46938

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

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

- Molecule 3 is PENTAETHYLENE GLYCOL (CCD ID: 1PE) (formula: C₁₀H₂₂O₆).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 16 10 6	0	0

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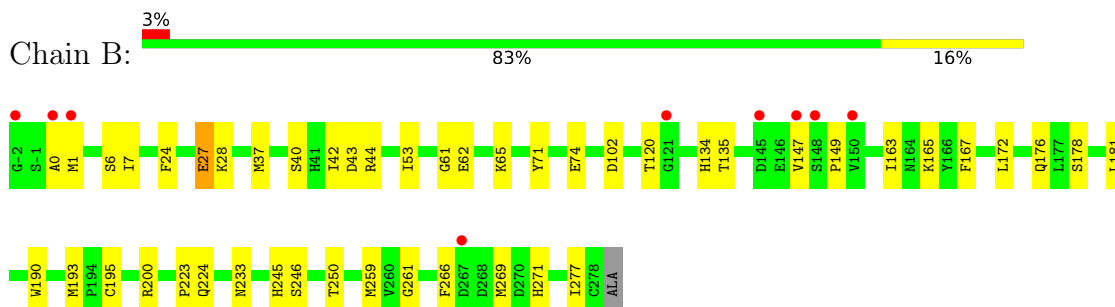
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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	B	1	Total	C	O	0	0
			16	10	6		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	216	Total	O	0	0
			216	216		
4	B	241	Total	O	0	0
			241	241		

- Molecule 1: 4-deoxy-L-threo-5-hexosulose-uronate ketol-isomerase



4 Data and refinement statistics

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, α , β , γ	102.97Å 102.97Å 176.86Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	12.97 – 1.94 12.97 – 1.94	Depositor EDS
% Data completeness (in resolution range)	99.4 (12.97-1.94) 99.6 (12.97-1.94)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	7.64 (at 1.95Å)	Xtriage
Refinement program	CNS	Depositor
R, R_{free}	0.164 , 0.191 0.167 , 0.161	Depositor DCC
R_{free} test set	2612 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	14.4	Xtriage
Anisotropy	0.058	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.44 , 62.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.068 for h,-h-k,-l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4890	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.28% 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, 1PE

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	0.34	0/2269	0.91	5/3058 (0.2%)
1	B	0.34	0/2269	0.93	11/3060 (0.4%)
All	All	0.34	0/4538	0.92	16/6118 (0.3%)

There are no bond length outliers.

All (16) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	250	THR	N-CA-C	-6.91	104.85	113.28
1	A	250	THR	N-CA-C	-6.63	105.23	113.38
1	A	6	SER	N-CA-C	-6.21	102.53	110.53
1	B	102	ASP	N-CA-C	-6.06	101.55	110.52
1	B	6[A]	SER	N-CA-C	-5.94	102.53	110.55
1	B	6[B]	SER	N-CA-C	-5.94	102.53	110.55
1	B	6[C]	SER	N-CA-C	-5.94	102.53	110.55
1	A	24	PHE	N-CA-C	5.88	120.73	113.50
1	A	102	ASP	N-CA-C	-5.87	101.83	110.52
1	B	24	PHE	N-CA-C	5.86	120.70	113.50
1	B	190	TRP	N-CA-C	5.67	118.88	109.46
1	A	190	TRP	N-CA-C	5.66	119.47	109.96
1	B	27	GLU	N-CA-C	5.33	118.00	111.82
1	B	7	ILE	N-CA-C	5.25	115.27	108.35
1	B	233	ASN	N-CA-C	5.23	118.05	110.42
1	B	200	ARG	N-CA-C	5.16	119.21	113.02

There are no chirality outliers.

There are no planarity outliers.

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	2200	0	2149	28	0
1	B	2199	0	2140	36	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	16	0	22	1	0
3	B	16	0	22	1	0
4	A	216	0	0	3	0
4	B	241	0	0	6	0
All	All	4890	0	4333	59	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 7.

All (59) 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:147:VAL:O	1:B:149:PRO:HD3	1.83	0.78
1:B:1[B]:MET:HE1	1:B:37:MSE:HB3	1.69	0.73
1:B:0:ALA:O	1:B:1[B]:MET:HE2	1.90	0.72
1:A:134:HIS:HD2	1:B:134:HIS:H	1.42	0.68
1:B:1[B]:MET:SD	1:B:37:MSE:SE	3.09	0.61
1:A:209:ASN:HB3	4:A:679:HOH:O	2.00	0.61
1:A:61:GLY:O	1:A:65:LYS:HD3	2.00	0.61
1:B:163:ILE:HG23	4:B:623:HOH:O	2.01	0.60
1:B:27:GLU:C	1:B:28:LYS:HD2	2.26	0.60
1:B:269:MSE:HE2	1:B:271:HIS:CD2	2.37	0.59
1:B:1[B]:MET:CE	1:B:37:MSE:HB3	2.34	0.58
1:B:165:LYS:HD3	3:B:504:1PE:H152	1.86	0.57
1:A:207:TYR:OH	1:A:218:HIS:HD2	1.88	0.56
1:A:266:PHE:O	1:A:269:MSE:HE3	2.05	0.56
1:A:218:HIS:HE1	4:A:518:HOH:O	1.89	0.55
1:A:161:ARG:HB3	1:A:184[B]:LEU:HD23	1.88	0.55
1:A:56:THR:HG22	1:A:116:ALA:HB2	1.87	0.55
1:A:1[B]:MET:HE3	1:A:37:MSE:SE	2.57	0.54
1:A:193:MSE:HA	1:A:194:PRO:C	2.33	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:149:PRO:HB3	1:A:164:ASN:OD1	2.10	0.52
1:B:176:GLN:HE21	1:B:261:GLY:H	1.59	0.51
1:A:134:HIS:HE1	4:B:545:HOH:O	1.92	0.51
1:A:135:THR:HB	1:B:135:THR:OG1	2.12	0.50
1:A:134:HIS:HB2	1:B:134:HIS:HB2	1.92	0.50
1:A:163:ILE:HG23	4:A:527:HOH:O	2.10	0.50
1:A:176:GLN:HE21	1:A:261:GLY:H	1.61	0.49
1:A:134:HIS:CD2	1:B:134:HIS:H	2.29	0.48
1:B:259:MSE:HE1	1:B:266:PHE:HD2	1.79	0.48
1:A:165:LYS:HD3	3:A:503:1PE:H152	1.95	0.48
1:B:167:PHE:O	1:B:178:SER:HA	2.14	0.48
1:B:269:MSE:HE2	1:B:271:HIS:NE2	2.28	0.48
1:B:53:ILE:O	1:B:120:THR:HG22	2.14	0.47
1:A:190:TRP:CE3	1:A:193:MSE:HG3	2.49	0.47
1:B:0:ALA:O	1:B:1[B]:MET:CE	2.61	0.47
1:B:62[B]:GLU:HG3	4:B:649:HOH:O	2.13	0.47
1:B:71:TYR:CE1	1:B:74:GLU:HA	2.50	0.47
1:B:223:PRO:O	1:B:277:ILE:HD12	2.15	0.46
1:B:259:MSE:CE	1:B:266:PHE:HD2	2.29	0.46
1:B:1[B]:MET:CE	4:B:694:HOH:O	2.64	0.46
1:B:28:LYS:HD2	1:B:28:LYS:N	2.31	0.46
1:B:42:ILE:O	1:B:43:ASP:HB2	2.16	0.46
1:B:224:GLN:HA	4:B:736:HOH:O	2.16	0.45
1:A:181:LEU:C	1:A:181:LEU:HD23	2.41	0.45
1:B:181:LEU:C	1:B:181:LEU:HD23	2.40	0.45
1:B:61:GLY:O	1:B:65:LYS:HD3	2.16	0.45
1:A:40:SER:O	1:A:44:ARG:HA	2.17	0.45
1:A:143:THR:HB	1:A:144:PRO:HD2	2.00	0.44
1:A:140[B]:LYS:NZ	1:A:146:GLU:OE1	2.50	0.44
1:B:1[B]:MET:HE3	4:B:694:HOH:O	2.17	0.44
1:A:134:HIS:HD2	1:B:134:HIS:N	2.13	0.44
1:B:1[B]:MET:HE1	1:B:37:MSE:CB	2.44	0.44
1:A:35:TYR:HB2	1:A:50:ILE:HG12	2.01	0.43
1:A:138:PRO:HG2	1:A:140[A]:LYS:HE3	2.01	0.43
1:A:25:LEU:HD13	1:A:231:MSE:HG2	2.02	0.42
1:B:40:SER:O	1:B:44:ARG:HA	2.20	0.42
1:B:147:VAL:C	1:B:149:PRO:HD3	2.46	0.41
1:B:195:CYS:HB3	1:B:246[B]:SER:OG	2.21	0.41
1:A:232:HIS:CD2	1:A:232:HIS:C	2.99	0.41

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	285/282 (101%)	276 (97%)	9 (3%)	0	100	100
1	B	285/282 (101%)	275 (96%)	10 (4%)	0	100	100
All	All	570/564 (101%)	551 (97%)	19 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	245/229 (107%)	244 (100%)	1 (0%)	84	84
1	B	245/229 (107%)	242 (99%)	3 (1%)	63	57
All	All	490/458 (107%)	486 (99%)	4 (1%)	73	71

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	245	HIS
1	B	172	LEU
1	B	193	MSE
1	B	245	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	18	GLN
1	A	41	HIS
1	A	94	GLN
1	A	134	HIS
1	A	155	ASN
1	A	176	GLN
1	A	218	HIS
1	A	264	GLN
1	A	271	HIS
1	B	18	GLN
1	B	155	ASN
1	B	176	GLN

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 4 ligands modelled in this entry, 2 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	$\# Z > 2$
3	1PE	B	504	-	15,15,15	0.56	0	14,14,14	0.58	0
3	1PE	A	503	-	15,15,15	0.57	0	14,14,14	0.56	0

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
3	1PE	B	504	-	-	4/13/13/13	-
3	1PE	A	503	-	-	4/13/13/13	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (8) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	503	1PE	OH7-C16-C26-OH6
3	B	504	1PE	OH7-C16-C26-OH6
3	A	503	1PE	OH6-C15-C25-OH5
3	A	503	1PE	C12-C22-OH3-C23
3	B	504	1PE	OH5-C14-C24-OH4
3	B	504	1PE	C14-C24-OH4-C13
3	A	503	1PE	C25-C15-OH6-C26
3	B	504	1PE	C13-C23-OH3-C22

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	504	1PE	1	0
3	A	503	1PE	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	270/282 (95%)	-0.42	5 (1%) 66 72	7, 12, 29, 40	6 (2%)
1	B	270/282 (95%)	-0.30	9 (3%) 49 55	7, 13, 31, 41	5 (1%)
All	All	540/564 (95%)	-0.36	14 (2%) 57 64	7, 13, 31, 41	11 (2%)

All (14) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	145	ASP	3.8
1	B	148	SER	3.5
1	A	145	ASP	3.0
1	B	267	ASP	3.0
1	B	121	GLY	2.7
1	A	267	ASP	2.7
1	B	-2	GLY	2.4
1	B	147	VAL	2.4
1	B	0	ALA	2.3
1	A	278	CYS	2.2
1	A	1[A]	MET	2.1
1	B	1[A]	MET	2.1
1	B	150	VAL	2.0
1	A	144	PRO	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
3	1PE	B	504	16/16	0.72	0.16	50,51,55,56	0
3	1PE	A	503	16/16	0.85	0.11	32,39,44,44	0
2	ZN	A	501	1/1	1.00	0.01	11,11,11,11	0
2	ZN	B	502	1/1	1.00	0.01	12,12,12,12	0

6.5 Other polymers [i](#)

There are no such residues in this entry.