



# Full wwPDB X-ray Structure Validation Report

Oct 2, 2014 – 08:39 PM EDT

PDB ID : 4UTX  
Title : Crystal structure of zebrafish Sirtuin 5 in complex with 3-nitro- propionylated CPS1-peptide  
Authors : Pannek, M.; Gertz, M.; Steegborn, C.  
Deposited on : 2014-07-23  
Resolution : 3.10 Å(reported)

This is a full wwPDB 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 <http://wwpdb.org/ValidationPDFNotes.html>

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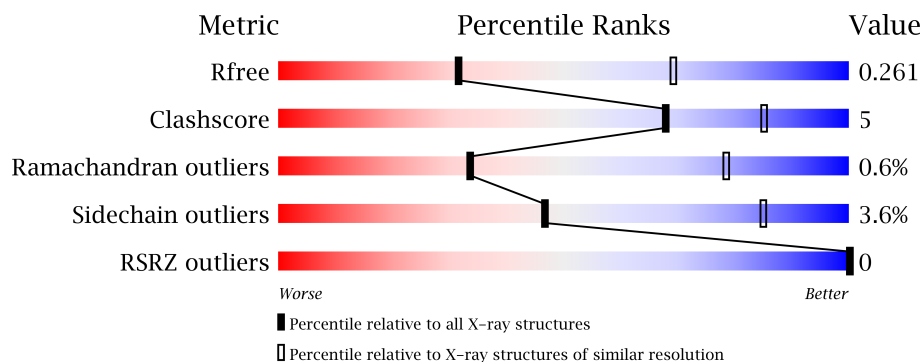
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.16 November 2013  
Xtriage (Phenix) : dev-1439  
EDS : stable23828  
Percentile statistics : 21963  
Refmac : 5.8.0049  
CCP4 : 6.3.0 (Settle)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : stable23828

# 1 Overall quality at a glance




The reported resolution of this entry is 3.10 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))
$R_{free}$	66092	1007 (3.18-3.02)
Clashscore	79885	1078 (3.16-3.04)
Ramachandran outliers	78287	1044 (3.16-3.04)
Sidechain outliers	78261	1044 (3.16-3.04)
RSRZ outliers	66119	1008 (3.18-3.02)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	275	
1	B	275	
2	C	9	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
4	EDO	A	1300	-	X
4	EDO	A	1301	-	X
4	EDO	B	1302	-	X
7	NA	B	1303	-	X
8	3NP	C	1004	-	X

## 2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 4193 atoms, of which 0 are hydrogen and 0 are deuterium.

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 NAD-DEPENDENT PROTEIN DEACYLASE SIRTUIN-5, MITOCHONDRIAL.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	262	Total	C	N	O	S	0	0	0
			2031	1281	365	370	15			
1	B	260	Total	C	N	O	S	0	0	0
			2019	1275	362	367	15			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	24	GLY	-	EXPRESSION TAG	UNP Q6DHI5
A	25	ILE	-	EXPRESSION TAG	UNP Q6DHI5
A	26	ASP	-	EXPRESSION TAG	UNP Q6DHI5
A	27	PRO	-	EXPRESSION TAG	UNP Q6DHI5
A	28	PHE	-	EXPRESSION TAG	UNP Q6DHI5
A	29	THR	-	EXPRESSION TAG	UNP Q6DHI5
B	24	GLY	-	EXPRESSION TAG	UNP Q6DHI5
B	25	ILE	-	EXPRESSION TAG	UNP Q6DHI5
B	26	ASP	-	EXPRESSION TAG	UNP Q6DHI5
B	27	PRO	-	EXPRESSION TAG	UNP Q6DHI5
B	28	PHE	-	EXPRESSION TAG	UNP Q6DHI5
B	29	THR	-	EXPRESSION TAG	UNP Q6DHI5

- Molecule 2 is a protein called CARBAMOYLPHOSPHATE SYNTHETASE I.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	9	Total	C	N	O	0	0	0
			68	47	9	12			

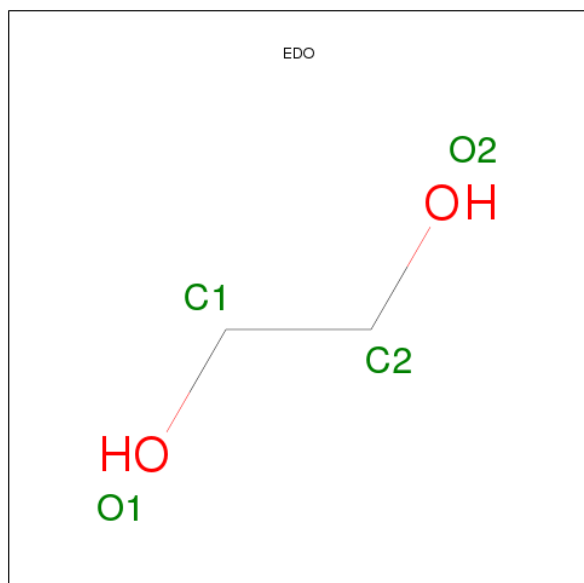
There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	0	BEZ	-	BENZOYLATION	UNP Q5R209

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

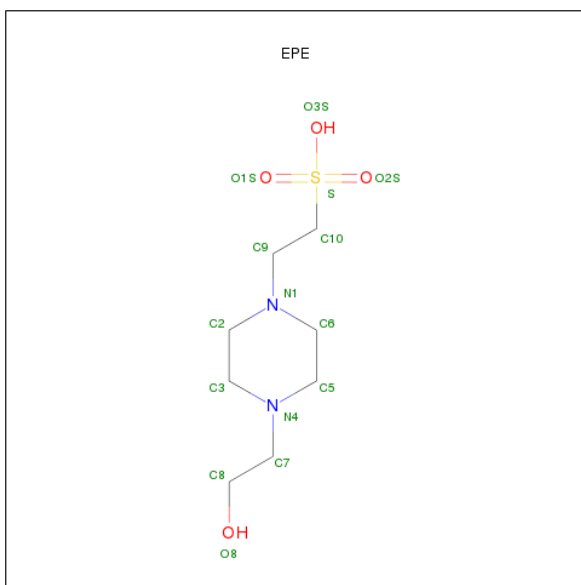
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	1	Total	Zn	0	0
			1	1		
3	A	1	Total	Zn	0	0
			1	1		

- Molecule 4 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>).



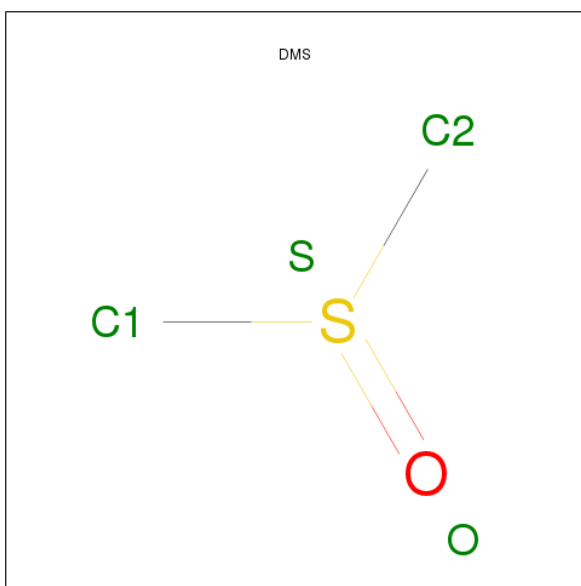
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			4	2	2		
4	A	1	Total	C	O	0	0
			4	2	2		
4	B	1	Total	C	O	0	0
			4	2	2		

- Molecule 5 is 4-(2-HYDROXYETHYL)-1-PIPERAZINEETHANESULFONIC 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
5	B	1	Total	C	N	O	S	0	0
			15	8	2	4	1		

- Molecule 6 is DIMETHYL SULFOXIDE (three-letter code: DMS) (formula:  $C_2H_6OS$ ).

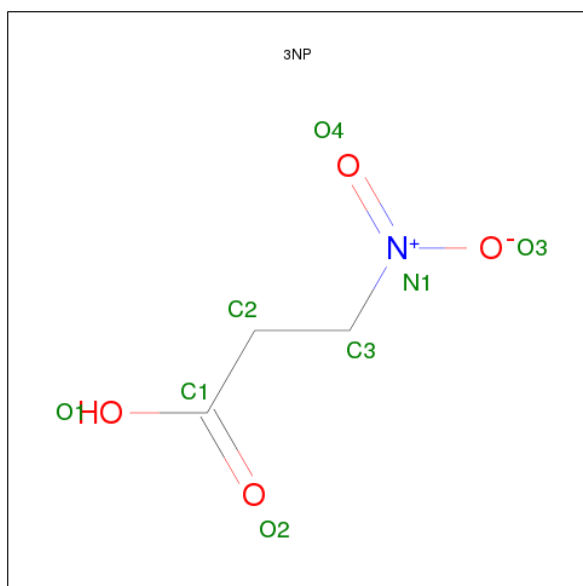


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	B	1	Total	C	O	S	0	0
			4	2	1	1		

- Molecule 7 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	B	1	Total	Na	0	0
			1	1		

- Molecule 8 is 3-NITROPROPANOIC ACID (three-letter code: 3NP) (formula:  $C_3H_5NO_4$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
8	C	1	Total	C	N	O	0	0
			7	3	1	3		

- Molecule 9 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
9	A	23	Total	O	0	0
			23	23		
9	B	11	Total	O	0	0
			11	11		



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 65 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	87.49Å 87.49Å 313.79Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.38 – 3.10 48.33 – 3.10	Depositor EDS
% Data completeness (in resolution range)	99.9 (48.38-3.10) 99.9 (48.33-3.10)	Depositor EDS
$R_{merge}$	0.21	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.12 (at 3.12Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, $R_{free}$	0.194 , 0.262 0.201 , 0.261	Depositor DCC
$R_{free}$ test set	714 reflections (5.47%)	DCC
Wilson B-factor (Å <sup>2</sup> )	70.0	Xtriage
Anisotropy	0.379	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 39.8	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.46$ , $\langle L^2 \rangle = 0.29$	Xtriage
Outliers	0 of 13762 reflections	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	4193	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	68.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.09% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.



## 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, NA, EDO, BEZ, DMS, 3NP, EPE

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	0.65	0/2084	0.82	1/2825 (0.0%)
1	B	0.64	0/2072	0.82	1/2806 (0.0%)
2	C	0.80	0/60	1.18	0/79
All	All	0.65	0/4216	0.83	2/5710 (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	B	123	ARG	NE-CZ-NH2	-6.05	117.27	120.30
1	A	205	ARG	NE-CZ-NH1	5.61	123.10	120.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2031	0	1995	20	1
1	B	2019	0	1980	21	0
2	C	68	0	66	2	0
3	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	1	0	0	0	0
4	A	8	0	12	1	0
4	B	4	0	6	0	0
5	B	15	0	18	1	0
6	B	4	0	6	0	0
7	B	1	0	0	0	0
8	C	7	0	4	0	0
9	A	23	0	0	1	0
9	B	11	0	0	0	0
All	All	4193	0	4087	40	1

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 5.

All (40) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:40:ARG:NH2	1:A:298:GLU:O	2.17	0.77
1:B:40:ARG:NH2	1:B:298:GLU:O	2.21	0.73
1:A:74:ARG:HA	1:A:188:PRO:HA	1.80	0.62
1:B:74:ARG:HA	1:B:188:PRO:HA	1.84	0.59
1:B:171:ASN:OD1	1:B:171:ASN:C	2.43	0.57
1:A:171:ASN:OD1	1:A:171:ASN:C	2.43	0.55
1:A:235:LEU:HD13	1:A:256:PHE:HB3	1.90	0.53
1:A:94:VAL:O	1:A:97:PHE:HB3	2.09	0.52
1:B:111:ASN:HB2	1:B:112:PRO:CD	2.39	0.52
1:A:111:ASN:HB2	1:A:112:PRO:CD	2.39	0.52
1:A:42:HIS:CD2	1:A:283:TYR:OH	2.63	0.51
2:C:8:VAL:O	2:C:8:VAL:HG12	2.11	0.50
1:B:260:VAL:CG1	1:B:265:VAL:HB	2.41	0.49
1:B:94:VAL:O	1:B:97:PHE:HB3	2.12	0.49
1:B:111:ASN:HB2	1:B:112:PRO:HD2	1.95	0.49
1:B:67:ARG:O	1:B:68:GLY:O	2.30	0.49
1:B:154:HIS:CE1	5:B:1300:EPE:H31	2.48	0.48
1:A:111:ASN:HB2	1:A:112:PRO:HD2	1.95	0.48
1:B:295:PRO:O	1:B:298:GLU:HG2	2.12	0.48
1:A:133:ILE:HD12	1:A:133:ILE:N	2.29	0.48
1:B:42:HIS:CD2	1:B:283:TYR:OH	2.66	0.48
1:B:60:GLU:OE2	1:B:289:CYS:N	2.47	0.48
1:B:136:GLN:HB3	1:B:154:HIS:CE1	2.50	0.47
1:A:60:GLU:OE2	1:A:289:CYS:N	2.48	0.47
1:A:47:LYS:HE3	9:A:2002:HOH:O	2.14	0.47
1:A:115:LEU:HB3	1:B:109:MET:HE2	1.97	0.46

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Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:164:SER:HB2	1:A:210:GLY:HA3	1.98	0.46
1:B:136:GLN:OE1	1:B:252:PRO:HD2	2.17	0.45
1:B:133:ILE:HD12	1:B:133:ILE:N	2.33	0.44
1:B:246:THR:OG1	1:B:247:SER:N	2.51	0.43
1:A:271:ASN:HB2	4:A:1301:EDO:H12	2.01	0.42
1:B:273:GLU:N	1:B:286:GLU:OE2	2.52	0.42
1:A:222:THR:HA	2:C:2:VAL:O	2.19	0.42
1:A:205:ARG:O	1:A:207:SER:N	2.53	0.42
1:A:115:LEU:HD11	1:B:115:LEU:HD11	2.03	0.41
1:A:283:TYR:CD1	1:A:283:TYR:N	2.89	0.41
1:B:167:GLU:OE1	1:B:205:ARG:HD2	2.21	0.40
1:A:163:MET:HG2	1:A:211:LEU:O	2.21	0.40
1:A:55:ALA:HB1	1:A:65:THR:HG21	2.03	0.40
1:B:52:ILE:HA	1:B:134:ILE:O	2.21	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:189:ASN:OD1	1:A:189:ASN:OD1[12_554]	2.14	0.06

## 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	258/275 (94%)	243 (94%)	14 (5%)	1 (0%)	43	84
1	B	256/275 (93%)	242 (94%)	12 (5%)	2 (1%)	27	74
2	C	7/9 (78%)	5 (71%)	2 (29%)	0	100	100
All	All	521/559 (93%)	490 (94%)	28 (5%)	3 (1%)	33	78

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	68	GLY
1	A	179	ALA
1	B	179	ALA

### 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	217/229 (95%)	209 (96%)	8 (4%)	45	84
1	B	216/229 (94%)	208 (96%)	8 (4%)	45	84
2	C	6/6 (100%)	6 (100%)	0	100	100
All	All	439/464 (95%)	423 (96%)	16 (4%)	47	85

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	37	THR
1	A	130	SER
1	A	132	VAL
1	A	136	GLN
1	A	164	SER
1	A	242	LEU
1	A	278	THR
1	A	283	TYR
1	B	34	SER
1	B	37	THR
1	B	130	SER
1	B	132	VAL
1	B	136	GLN
1	B	229	THR
1	B	238	CYS
1	B	242	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	42	HIS
1	A	143	HIS
1	B	42	HIS
1	B	284	HIS

### 5.3.3 RNA ⓘ

There are no RNA chains 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 carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

Of 9 ligands modelled in this entry, 3 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	$\# Z  > 2$
4	EDO	A	1300	-	3,3,3	0.80	0	2,2,2	0.18	0
4	EDO	A	1301	-	3,3,3	0.62	0	2,2,2	0.38	0
5	EPE	B	1300	-	15,15,15	1.75	2 (13%)	20,20,20	2.47	6 (30%)
6	DMS	B	1301	-	3,3,3	0.40	0	3,3,3	1.24	0
4	EDO	B	1302	-	3,3,3	0.91	0	2,2,2	0.48	0
8	3NP	C	1004	2	6,6,7	7.59	3 (50%)	4,6,8	2.63	2 (50%)

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	EDO	A	1300	-	-	0/1/1/1	0/0/0/0
4	EDO	A	1301	-	-	0/1/1/1	0/0/0/0
5	EPE	B	1300	-	-	0/9/19/19	0/1/1/1
6	DMS	B	1301	-	-	0/0/0/0	0/0/0/0
4	EDO	B	1302	-	-	0/1/1/1	0/0/0/0
8	3NP	C	1004	2	-	0/3/4/5	0/0/0/0

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
8	C	1004	3NP	O2-C1	17.28	1.23	1.11
5	B	1300	EPE	C10-S	-6.05	1.68	1.77
8	C	1004	3NP	O3-N1	5.18	1.36	1.23
8	C	1004	3NP	O4-N1	4.44	1.33	1.22
5	B	1300	EPE	O3S-S	2.43	1.52	1.46

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	B	1300	EPE	O3S-S-C10	6.75	114.07	105.93
5	B	1300	EPE	O3S-S-O1S	4.50	121.69	111.69
5	B	1300	EPE	O2S-S-O1S	-4.10	99.19	113.45
8	C	1004	3NP	C2-C3-N1	-3.66	104.53	110.98
8	C	1004	3NP	O3-N1-O4	-3.50	117.56	122.73
5	B	1300	EPE	O3S-S-O2S	-3.40	104.13	111.69
5	B	1300	EPE	C10-C9-N1	-3.13	101.67	113.39
5	B	1300	EPE	C3-C2-N1	-2.19	106.33	110.61

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 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, 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	262/275 (95%)	-0.24	0 100 100	40, 58, 92, 120	0
1	B	260/275 (94%)	-0.11	0 100 100	41, 69, 112, 132	0
2	C	9/9 (100%)	-0.17	0 100 100	54, 63, 70, 72	0
All	All	531/559 (94%)	-0.17	0 100 100	40, 63, 108, 132	0

There are no RSRZ outliers to report.

### 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 ⓘ

There are no carbohydrates in this entry.

### 6.4 Ligands ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
7	NA	B	1303	1/1	0.38	55.67	65,65,65,65	1
4	EDO	A	1301	4/4	0.28	3.33	69,70,74,78	0
4	EDO	A	1300	4/4	0.24	3.32	48,52,55,58	0

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Mol	Type	Chain	Res	Atoms	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
8	3NP	C	1004	7/8	0.29	2.71	80,87,94,95	0
4	EDO	B	1302	4/4	0.27	2.45	56,56,63,64	0
5	EPE	B	1300	15/15	0.19	-0.30	50,62,77,78	0
3	ZN	A	1299	1/1	0.10	-0.83	51,51,51,51	0
6	DMS	B	1301	4/4	0.15	-0.93	52,54,57,60	0
3	ZN	B	1299	1/1	0.11	-1.36	92,92,92,92	0

## 6.5 Other polymers ⓘ

There are no such residues in this entry.