



# Full wwPDB X-ray Structure Validation Report ⓘ

Oct 25, 2023 – 12:22 PM EDT

PDB ID : 3AL9  
Title : Mouse Plexin A2 extracellular domain  
Authors : Nogi, T.; Yasui, N.; Mihara, E.; Takagi, J.  
Deposited on : 2010-07-28  
Resolution : 2.10 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 : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
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

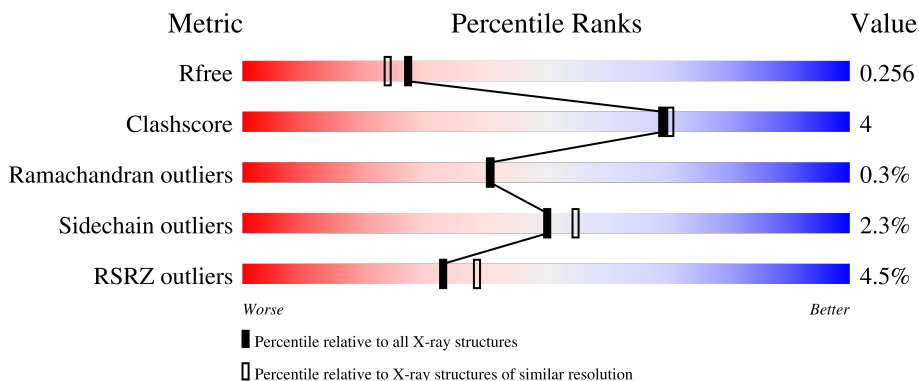
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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))
$R_{free}$	130704	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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	539	 5% 87% 8% . .
1	B	539	 4% 83% 13% .

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 8604 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 Plexin-A2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	516	4059	2578	693	763	25	0	0	0
1	B	516	4059	2578	693	763	25	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

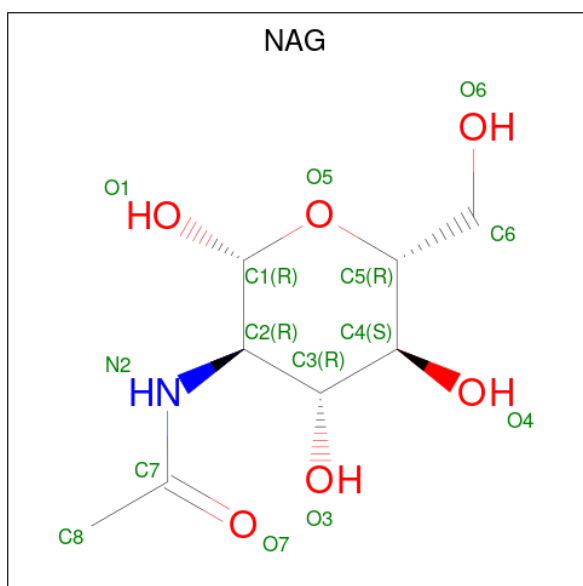
Chain	Residue	Modelled	Actual	Comment	Reference
A	562	SER	-	expression tag	UNP P70207
A	563	ARG	-	expression tag	UNP P70207
A	564	GLU	-	expression tag	UNP P70207
A	565	ASN	-	expression tag	UNP P70207
A	566	LEU	-	expression tag	UNP P70207
A	567	TYR	-	expression tag	UNP P70207
A	568	PHE	-	expression tag	UNP P70207
A	569	GLN	-	expression tag	UNP P70207
B	562	SER	-	expression tag	UNP P70207
B	563	ARG	-	expression tag	UNP P70207
B	564	GLU	-	expression tag	UNP P70207
B	565	ASN	-	expression tag	UNP P70207
B	566	LEU	-	expression tag	UNP P70207
B	567	TYR	-	expression tag	UNP P70207
B	568	PHE	-	expression tag	UNP P70207
B	569	GLN	-	expression tag	UNP P70207

- Molecule 2 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
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0

- Molecule 3 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula:  $C_8H_{15}NO_6$ ).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	B	1	Total	C	N	O	0	0
			14	8	1	5		

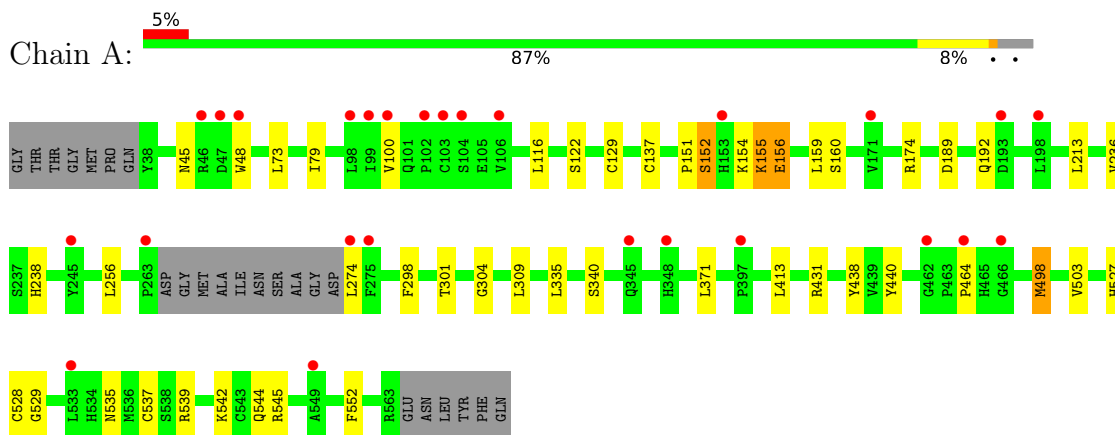
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	225	Total	O	0	0
			225	225		
4	B	235	Total	O	0	0
			235	235		

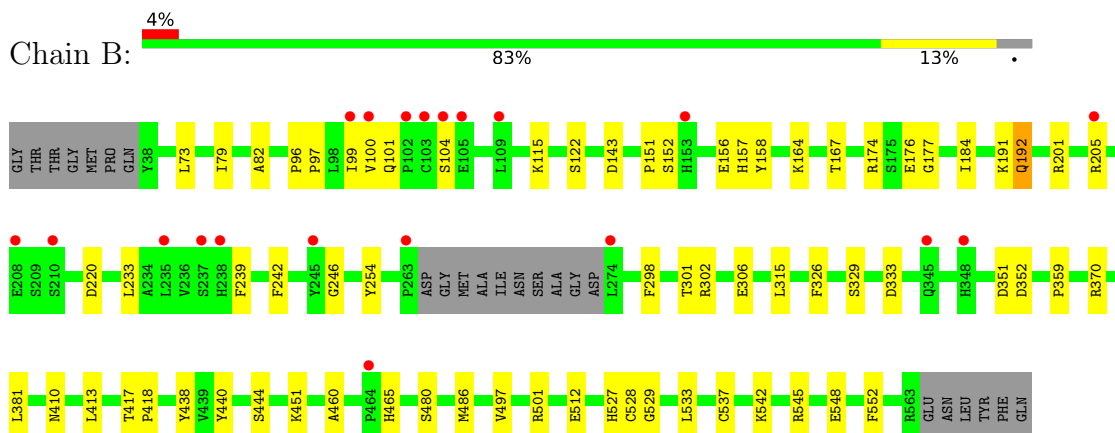
### 3 Residue-property plots [i](#)

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: Plexin-A2



#### • Molecule 1: Plexin-A2



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	55.70Å 60.68Å 95.39Å 109.80° 92.47° 112.53°	Depositor
Resolution (Å)	42.56 – 2.10 42.55 – 2.10	Depositor EDS
% Data completeness (in resolution range)	98.0 (42.56-2.10) 98.0 (42.55-2.10)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.53 (at 2.10Å)	Xtrriage
Refinement program	REFMAC 5.5.0072	Depositor
R, $R_{free}$	0.205 , 0.257 0.204 , 0.256	Depositor DCC
$R_{free}$ test set	3075 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	25.3	Xtrriage
Anisotropy	0.396	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.38 , 51.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	8604	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	25.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 9.55% 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

### 5.1 Standard geometry

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

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	0.53	0/4156	0.63	0/5637
1	B	0.54	0/4156	0.63	0/5637
All	All	0.54	0/8312	0.63	0/11274

There are no bond length outliers.

There are no bond angle outliers.

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	4059	0	3967	26	0
1	B	4059	0	3966	34	0
2	A	8	0	12	3	0
2	B	4	0	6	0	0
3	B	14	0	13	0	0
4	A	225	0	0	1	0
4	B	235	0	0	2	0
All	All	8604	0	7964	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 4.



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:512:GLU:HG3	4:B:8028:HOH:O	1.58	1.03
1:B:177:GLY:HA2	1:B:205:ARG:HH21	1.28	0.96
1:A:304:GLY:H	2:A:8302:EDO:H22	1.44	0.82
1:A:154:LYS:HB3	1:A:156:GLU:OE2	1.87	0.75
1:B:177:GLY:HA2	1:B:205:ARG:NH2	2.05	0.72
1:B:233:LEU:HD23	1:B:239:PHE:HB3	1.73	0.71
1:A:304:GLY:N	2:A:8302:EDO:H22	2.11	0.65
1:B:96:PRO:HB2	1:B:100:VAL:HG21	1.81	0.63
1:B:79:ILE:HD11	1:B:82:ALA:HB2	1.79	0.63
1:A:73:LEU:HD23	1:A:79:ILE:HA	1.82	0.61
1:A:122:SER:HB3	1:A:174:ARG:HD2	1.86	0.58
1:A:301:THR:HB	2:A:8302:EDO:H21	1.85	0.57
1:A:544:GLN:HG2	1:A:545:ARG:HG3	1.87	0.57
1:B:351:ASP:OD1	1:B:451:LYS:CE	2.57	0.53
1:A:151:PRO:HG2	1:A:213:LEU:HD12	1.91	0.52
1:B:529:GLY:HA3	1:B:552:PHE:CZ	2.44	0.51
1:A:137:CYS:SG	1:A:159:LEU:HD12	2.50	0.51
1:A:539:ARG:HD3	1:A:542:LYS:HD3	1.93	0.51
1:B:156:GLU:HB2	1:B:201:ARG:NH1	2.26	0.51
1:A:100:VAL:HG11	1:A:152:SER:O	2.10	0.50
1:A:528:CYS:HB3	1:A:537:CYS:SG	2.52	0.50
1:B:480:SER:OG	1:B:501:ARG:NH2	2.45	0.50
1:B:301:THR:HG22	1:B:306:GLU:HA	1.94	0.49
1:B:381:LEU:HD21	1:B:410:ASN:HA	1.95	0.49
1:A:440:TYR:CE2	1:A:527:HIS:HA	2.48	0.49
1:B:370:ARG:HG3	1:B:413:LEU:HD21	1.96	0.48
1:B:73:LEU:HD23	1:B:79:ILE:HA	1.96	0.47
1:B:326:PHE:CG	1:B:359:PRO:HG3	2.48	0.47
1:B:122:SER:HB3	1:B:174:ARG:HD2	1.96	0.47
1:B:440:TYR:CE2	1:B:527:HIS:HA	2.50	0.46
1:B:545:ARG:NH1	1:B:548:GLU:OE1	2.48	0.46
1:B:246:GLY:HA2	1:B:254:TYR:O	2.15	0.46
1:A:256:LEU:HD11	1:A:335:LEU:HD21	1.98	0.45
1:B:444:SER:HB2	1:B:460:ALA:HB3	1.99	0.45
1:A:116:LEU:HB3	1:A:129:CYS:HB2	1.98	0.44
1:B:486:MET:SD	1:B:497:VAL:HG22	2.57	0.44
1:B:99:ILE:HG21	1:B:152:SER:HB2	2.00	0.44
1:A:529:GLY:HA3	1:A:552:PHE:CZ	2.53	0.44
1:B:315:LEU:HD11	1:B:333:ASP:HB3	2.00	0.44
1:B:97:PRO:HG2	1:B:158:TYR:CE1	2.53	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:137:CYS:SG	1:A:159:LEU:CD1	3.06	0.43
1:B:100:VAL:HG23	1:B:101:GLN:H	1.82	0.43
1:A:155:LYS:HD2	1:B:220:ASP:CG	2.39	0.43
1:A:236:VAL:HG13	1:A:238:HIS:CE1	2.54	0.43
1:B:115:LYS:HE2	1:B:115:LYS:HB3	1.72	0.43
1:B:351:ASP:OD1	1:B:451:LYS:HE2	2.18	0.42
1:B:192:GLN:NE2	4:B:8192:HOH:O	2.52	0.42
1:B:151:PRO:O	1:B:157:HIS:HB3	2.19	0.42
1:A:238:HIS:CE1	1:A:274:LEU:HD22	2.55	0.41
1:B:167:THR:HG22	1:B:242:PHE:HD1	1.85	0.41
1:B:528:CYS:HB3	1:B:537:CYS:SG	2.60	0.41
1:A:238:HIS:NE2	1:A:274:LEU:HD22	2.36	0.41
1:A:431:ARG:HD3	4:A:8099:HOH:O	2.20	0.41
1:B:417:THR:HA	1:B:418:PRO:HD3	1.93	0.41
1:A:371:LEU:HD23	1:A:413:LEU:HD22	2.03	0.40
1:B:302:ARG:NH2	1:B:465:HIS:O	2.43	0.40
1:A:45:ASN:HB2	1:A:48:TRP:HB2	2.04	0.40
1:A:309:LEU:HB2	1:A:340:SER:HB2	2.04	0.40
1:A:498:MET:HB3	1:A:503:VAL:HG22	2.03	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	512/539 (95%)	501 (98%)	8 (2%)	3 (1%)	25	21
1	B	512/539 (95%)	498 (97%)	14 (3%)	0	100	100
All	All	1024/1078 (95%)	999 (98%)	22 (2%)	3 (0%)	41	41

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	152	SER
1	A	160	SER
1	A	464	PRO

### 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	451/468 (96%)	443 (98%)	8 (2%)	59 65
1	B	451/468 (96%)	438 (97%)	13 (3%)	42 46
All	All	902/936 (96%)	881 (98%)	21 (2%)	50 55

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

Mol	Chain	Res	Type
1	A	155	LYS
1	A	156	GLU
1	A	189	ASP
1	A	192	GLN
1	A	298	PHE
1	A	438	TYR
1	A	498	MET
1	A	535	ASN
1	B	104	SER
1	B	143	ASP
1	B	164	LYS
1	B	176	GLU
1	B	184	ILE
1	B	191	LYS
1	B	192	GLN
1	B	298	PHE
1	B	329	SER
1	B	352	ASP
1	B	438	TYR
1	B	533	LEU
1	B	542	LYS

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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

4 ligands are modelled in this entry.

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	$\# Z  > 2$
2	EDO	A	8301	-	3,3,3	0.45	0	2,2,2	0.29	0
2	EDO	B	8301	-	3,3,3	0.53	0	2,2,2	0.26	0
3	NAG	B	9101	1	14,14,15	0.49	0	17,19,21	1.15	1 (5%)
2	EDO	A	8302	-	3,3,3	0.42	0	2,2,2	0.44	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
2	EDO	A	8301	-	-	1/1/1/1	-
2	EDO	B	8301	-	-	0/1/1/1	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	NAG	B	9101	1	-	0/6/23/26	0/1/1/1
2	EDO	A	8302	-	-	1/1/1/1	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	9101	NAG	C1-O5-C5	3.38	116.78	112.19

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	8302	EDO	O1-C1-C2-O2
2	A	8301	EDO	O1-C1-C2-O2

There are no ring outliers.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	8302	EDO	3	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

### 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	516/539 (95%)	0.17	26 (5%) 28 34	12, 24, 39, 55	0
1	B	516/539 (95%)	0.20	20 (3%) 39 45	10, 24, 40, 58	0
All	All	1032/1078 (95%)	0.18	46 (4%) 33 38	10, 24, 40, 58	0

All (46) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	99	ILE	6.7
1	B	103	CYS	6.4
1	A	99	ILE	6.2
1	A	104	SER	5.5
1	B	100	VAL	5.4
1	A	100	VAL	5.0
1	B	104	SER	4.8
1	A	103	CYS	4.6
1	A	106	VAL	3.7
1	B	464	PRO	3.5
1	A	102	PRO	3.4
1	B	238	HIS	3.3
1	A	153	HIS	3.3
1	B	102	PRO	3.3
1	A	98	LEU	3.3
1	B	153	HIS	3.2
1	A	464	PRO	3.2
1	B	345	GLN	2.9
1	A	47	ASP	2.9
1	A	466	GLY	2.9
1	A	263	PRO	2.8
1	A	397	PRO	2.8
1	B	208	GLU	2.7
1	B	210	SER	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	533	LEU	2.6
1	B	348	HIS	2.6
1	B	237	SER	2.5
1	A	348	HIS	2.4
1	A	274	LEU	2.4
1	A	48	TRP	2.4
1	B	235	LEU	2.4
1	A	46	ARG	2.3
1	A	171	VAL	2.3
1	A	549	ALA	2.3
1	B	105	GLU	2.2
1	B	109	LEU	2.2
1	A	198	LEU	2.2
1	B	274	LEU	2.2
1	A	193	ASP	2.1
1	A	275	PHE	2.1
1	A	462	GLY	2.1
1	B	245	TYR	2.1
1	B	263	PRO	2.0
1	A	245	TYR	2.0
1	B	205	ARG	2.0
1	A	345	GLN	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, 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( $\text{\AA}^2$ )	Q<0.9
3	NAG	B	9101	14/15	0.85	0.21	32,36,38,41	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	EDO	A	8302	4/4	0.88	0.17	36,37,38,41	0
2	EDO	A	8301	4/4	0.95	0.10	30,31,32,33	0
2	EDO	B	8301	4/4	0.97	0.17	19,22,22,23	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.