



wwPDB X-ray Structure Validation Summary Report ⓘ

May 29, 2020 – 09:54 pm BST

PDB ID : 3PU3
Title : PHF2 Jumonji domain-NOG complex
Authors : Horton, J.R.; Upadhyay, A.K.; Hashimoto, H.; Zhang, X.; Cheng, X.
Deposited on : 2010-12-03
Resolution : 1.95 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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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 : 2.11
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) : 2.11

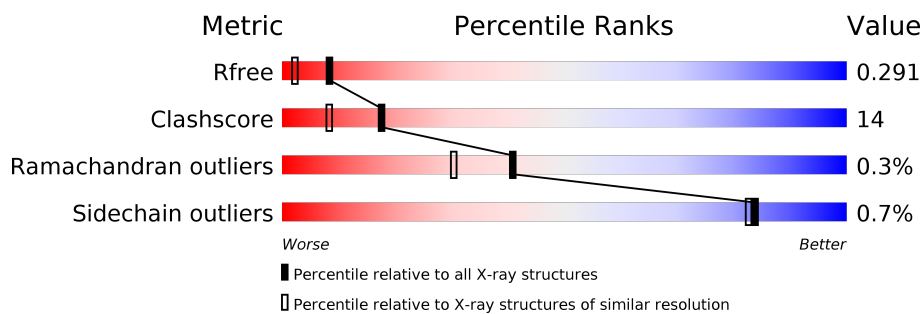
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.95 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	2580 (1.96-1.96)
Clashscore	141614	2705 (1.96-1.96)
Ramachandran outliers	138981	2678 (1.96-1.96)
Sidechain outliers	138945	2678 (1.96-1.96)

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 ≥ 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	392	
1	B	392	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	EDO	A	11	-	-	X	-
3	EDO	A	24	-	-	X	-
3	EDO	A	5	-	-	X	-

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	EDO	A	6	-	-	X	-
3	EDO	B	21	-	-	X	-

2 Entry composition [i](#)

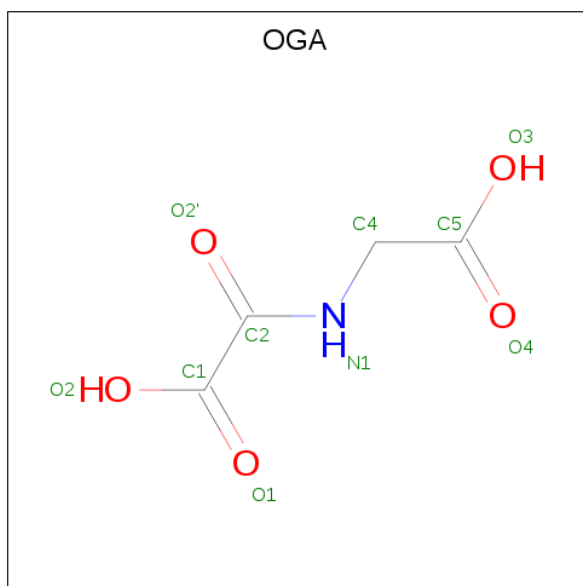
There are 5 unique types of molecules in this entry. The entry contains 6325 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 PHD finger protein 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	363	Total	C	N	O	S	0	7	0
			2901	1866	488	532	15			
1	B	361	Total	C	N	O	S	0	6	0
			2853	1840	475	523	15			

- Molecule 2 is N-OXALYLGLYCINE (three-letter code: OGA) (formula: $C_4H_5NO_5$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			10	4	1	5		
2	B	1	Total	C	N	O	0	0
			10	4	1	5		

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).



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

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

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

- Molecule 4 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



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

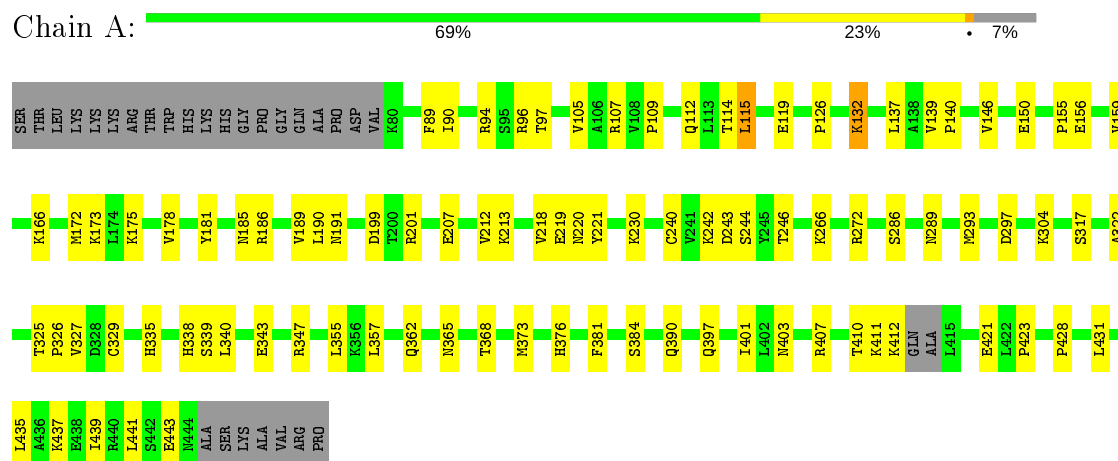
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	191	Total 191	O 191	0	0
5	B	182	Total 182	O 182	0	0

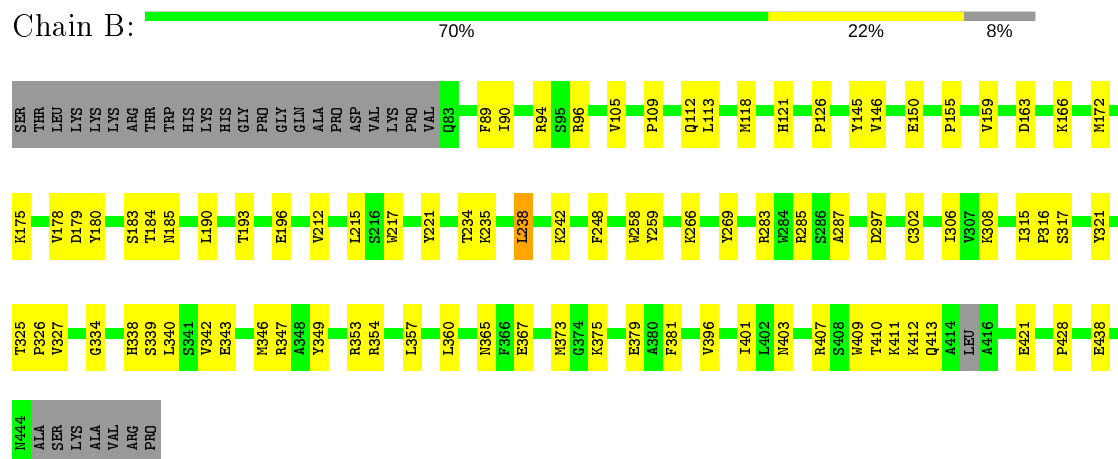
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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. 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. 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: PHD finger protein 2



- Molecule 1: PHD finger protein 2



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	65.91Å 96.33Å 66.37Å 90.00° 89.91° 90.00°	Depositor
Resolution (Å)	31.18 – 1.95 31.18 – 1.95	Depositor EDS
% Data completeness (in resolution range)	97.2 (31.18-1.95) 97.2 (31.18-1.95)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.55 (at 1.95Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.6.1_357)	Depositor
R, R_{free}	0.226 , 0.294 0.224 , 0.291	Depositor DCC
R_{free} test set	2031 reflections (3.37%)	wwPDB-VP
Wilson B-factor (Å ²)	20.9	Xtriage
Anisotropy	0.858	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 32.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.43$, $\langle L^2 \rangle = 0.25$	Xtriage
Estimated twinning fraction	0.059 for -l,k,h 0.467 for h,-k,-l 0.063 for -l,-k,-h	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	6325	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.86% 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: GOL, OGA, 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	0.42	0/2994	0.53	0/4066
1	B	0.42	0/2949	0.50	0/4008
All	All	0.42	0/5943	0.52	0/8074

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	2901	0	2792	77	0
1	B	2853	0	2725	77	0
2	A	10	0	3	0	0
2	B	10	0	3	1	0
3	A	88	0	132	30	0
3	B	84	0	126	21	0
4	A	6	0	8	1	0
5	A	191	0	0	11	0
5	B	182	0	0	9	0
All	All	6325	0	5789	161	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 14.

The worst 5 of 161 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:347:ARG:HH11	3:B:31:EDO:H11	1.08	1.17
1:B:347:ARG:NH1	3:B:31:EDO:H11	1.82	0.95
1:B:94:ARG:HH22	1:B:326:PRO:HA	1.31	0.95
1:A:213:LYS:HG2	3:A:16:EDO:H22	1.50	0.91
1:B:146:VAL:H	3:B:21:EDO:H22	1.36	0.89

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	366/392 (93%)	353 (96%)	12 (3%)	1 (0%)	41	30
1	B	363/392 (93%)	353 (97%)	9 (2%)	1 (0%)	41	30
All	All	729/784 (93%)	706 (97%)	21 (3%)	2 (0%)	41	30

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	360	LEU
1	A	411	LYS

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	308/345 (89%)	305 (99%)	3 (1%)	76	74
1	B	299/345 (87%)	298 (100%)	1 (0%)	92	92
All	All	607/690 (88%)	603 (99%)	4 (1%)	84	82

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

Mol	Chain	Res	Type
1	A	115	LEU
1	A	132	LYS
1	A	289	ASN
1	B	238	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	365	ASN
1	B	365	ASN
1	A	376	HIS
1	A	220	ASN
1	B	194	ASN

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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

46 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
3	EDO	A	14	-	3,3,3	0.51	0	2,2,2	0.20	0
3	EDO	B	28	-	3,3,3	0.46	0	2,2,2	0.59	0
3	EDO	B	452	-	3,3,3	0.60	0	2,2,2	0.28	0
3	EDO	B	29	-	3,3,3	0.44	0	2,2,2	0.34	0
3	EDO	A	23	-	3,3,3	0.44	0	2,2,2	0.37	0
3	EDO	A	26	-	3,3,3	0.50	0	2,2,2	0.38	0
3	EDO	A	42	-	3,3,3	0.44	0	2,2,2	0.42	0
3	EDO	A	27	-	3,3,3	0.48	0	2,2,2	0.25	0
3	EDO	B	1	-	3,3,3	0.40	0	2,2,2	0.52	0
2	OGA	B	2	-	3,9,9	3.37	1 (33%)	4,11,11	2.63	2 (50%)
3	EDO	B	21	-	3,3,3	0.46	0	2,2,2	0.44	0
3	EDO	A	10	-	3,3,3	0.48	0	2,2,2	0.37	0
3	EDO	B	7	-	3,3,3	0.50	0	2,2,2	0.30	0
4	GOL	A	12	-	5,5,5	0.39	0	5,5,5	0.15	0
3	EDO	B	45	-	3,3,3	0.49	0	2,2,2	0.28	0
3	EDO	A	33	-	3,3,3	0.47	0	2,2,2	0.43	0
3	EDO	B	43	-	3,3,3	0.42	0	2,2,2	0.33	0
3	EDO	A	46	-	3,3,3	0.47	0	2,2,2	0.28	0
3	EDO	A	36	-	3,3,3	0.47	0	2,2,2	0.29	0
3	EDO	A	11	-	3,3,3	0.42	0	2,2,2	0.40	0
3	EDO	A	6	-	3,3,3	0.36	0	2,2,2	0.55	0
3	EDO	A	18	-	3,3,3	0.48	0	2,2,2	0.28	0
3	EDO	B	40	-	3,3,3	0.46	0	2,2,2	0.34	0
3	EDO	A	34	-	3,3,3	0.47	0	2,2,2	0.27	0
3	EDO	B	41	-	3,3,3	0.48	0	2,2,2	0.17	0
3	EDO	A	17	-	3,3,3	0.46	0	2,2,2	0.41	0
3	EDO	B	47	-	3,3,3	0.47	0	2,2,2	0.34	0
3	EDO	A	16	-	3,3,3	0.52	0	2,2,2	0.31	0
3	EDO	A	37	-	3,3,3	0.50	0	2,2,2	0.25	0
3	EDO	B	4	-	3,3,3	0.49	0	2,2,2	0.35	0
3	EDO	B	49	-	3,3,3	0.46	0	2,2,2	0.38	0
3	EDO	B	48	-	3,3,3	0.46	0	2,2,2	0.34	0
3	EDO	B	39	-	3,3,3	0.46	0	2,2,2	0.42	0
3	EDO	B	30	-	3,3,3	0.49	0	2,2,2	0.23	0
3	EDO	B	31	-	3,3,3	0.43	0	2,2,2	0.24	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
3	EDO	A	35	-	3,3,3	0.43	0	2,2,2	0.35	0
3	EDO	A	9	-	3,3,3	0.48	0	2,2,2	0.36	0
2	OGA	A	1	-	3,9,9	3.20	1 (33%)	4,11,11	1.30	0
3	EDO	B	44	-	3,3,3	0.48	0	2,2,2	0.35	0
3	EDO	A	5	-	3,3,3	0.49	0	2,2,2	0.24	0
3	EDO	A	19	-	3,3,3	0.42	0	2,2,2	0.34	0
3	EDO	B	13	-	3,3,3	0.54	0	2,2,2	0.31	0
3	EDO	B	38	-	3,3,3	0.48	0	2,2,2	0.40	0
3	EDO	A	20	-	3,3,3	0.51	0	2,2,2	0.21	0
3	EDO	B	22	-	3,3,3	0.39	0	2,2,2	0.62	0
3	EDO	A	24	-	3,3,3	0.46	0	2,2,2	0.31	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	EDO	A	14	-	-	0/1/1/1	-
3	EDO	B	28	-	-	1/1/1/1	-
3	EDO	B	452	-	-	1/1/1/1	-
3	EDO	B	29	-	-	0/1/1/1	-
3	EDO	A	23	-	-	0/1/1/1	-
3	EDO	A	26	-	-	1/1/1/1	-
3	EDO	A	42	-	-	1/1/1/1	-
3	EDO	A	27	-	-	0/1/1/1	-
3	EDO	B	1	-	-	1/1/1/1	-
2	OGA	B	2	-	-	0/3/9/9	-
3	EDO	B	21	-	-	0/1/1/1	-
3	EDO	A	10	-	-	0/1/1/1	-
3	EDO	B	7	-	-	0/1/1/1	-
4	GOL	A	12	-	-	3/4/4/4	-
3	EDO	B	45	-	-	0/1/1/1	-
3	EDO	A	33	-	-	0/1/1/1	-
3	EDO	B	43	-	-	0/1/1/1	-
3	EDO	A	46	-	-	0/1/1/1	-
3	EDO	A	36	-	-	0/1/1/1	-
3	EDO	A	11	-	-	0/1/1/1	-
3	EDO	A	6	-	-	0/1/1/1	-
3	EDO	A	18	-	-	1/1/1/1	-
3	EDO	B	40	-	-	0/1/1/1	-
3	EDO	A	34	-	-	0/1/1/1	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	EDO	B	41	-	-	0/1/1/1	-
3	EDO	A	17	-	-	0/1/1/1	-
3	EDO	B	47	-	-	0/1/1/1	-
3	EDO	A	16	-	-	1/1/1/1	-
3	EDO	A	37	-	-	0/1/1/1	-
3	EDO	B	4	-	-	1/1/1/1	-
3	EDO	B	49	-	-	0/1/1/1	-
3	EDO	B	48	-	-	0/1/1/1	-
3	EDO	B	39	-	-	0/1/1/1	-
3	EDO	B	30	-	-	0/1/1/1	-
3	EDO	B	31	-	-	0/1/1/1	-
3	EDO	A	35	-	-	0/1/1/1	-
3	EDO	A	9	-	-	0/1/1/1	-
2	OGA	A	1	-	-	0/3/9/9	-
3	EDO	B	44	-	-	0/1/1/1	-
3	EDO	A	5	-	-	1/1/1/1	-
3	EDO	A	19	-	-	0/1/1/1	-
3	EDO	B	13	-	-	1/1/1/1	-
3	EDO	B	38	-	-	0/1/1/1	-
3	EDO	A	20	-	-	0/1/1/1	-
3	EDO	B	22	-	-	0/1/1/1	-
3	EDO	A	24	-	-	1/1/1/1	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	2	OGA	C2-N1	5.84	1.46	1.33
2	A	1	OGA	C2-N1	5.54	1.45	1.33

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	2	OGA	C1-C2-N1	4.48	120.05	115.60
2	B	2	OGA	O2'-C2-N1	-2.31	118.01	122.61

There are no chirality outliers.

5 of 14 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	12	GOL	O1-C1-C2-C3
4	A	12	GOL	O1-C1-C2-O2

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Mol	Chain	Res	Type	Atoms
3	A	26	EDO	O1-C1-C2-O2
3	A	18	EDO	O1-C1-C2-O2
3	A	16	EDO	O1-C1-C2-O2

There are no ring outliers.

26 monomers are involved in 53 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	452	EDO	2	0
3	B	29	EDO	1	0
3	A	23	EDO	3	0
3	A	42	EDO	1	0
2	B	2	OGA	1	0
3	B	21	EDO	5	0
3	B	7	EDO	1	0
4	A	12	GOL	1	0
3	B	45	EDO	1	0
3	B	43	EDO	2	0
3	A	46	EDO	3	0
3	A	11	EDO	4	0
3	A	6	EDO	7	0
3	A	34	EDO	1	0
3	B	41	EDO	1	0
3	A	16	EDO	2	0
3	A	37	EDO	1	0
3	B	49	EDO	1	0
3	B	48	EDO	1	0
3	B	31	EDO	3	0
3	A	35	EDO	1	0
3	A	9	EDO	1	0
3	A	5	EDO	4	0
3	B	13	EDO	1	0
3	B	22	EDO	3	0
3	A	24	EDO	4	0

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 ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

6.3 Carbohydrates ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

6.4 Ligands ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.

6.5 Other polymers ⓘ

Unable to reproduce the depositors R factor - this section is therefore empty.