



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 1, 2026 – 04:19 PM UTC

PDB ID : 1VXO / pdb_00001vxo
Title : METHYLPHOSPHONYLATED ACETYLCHOLINESTERASE (AGED)
OBTAINED BY REACTION WITH O-ETHYL-S-[2-[BIS(1-METHYLETHYL)AMINO]ETHYL] METHYLPHOSPHONOTHIOATE (VX)
Authors : Millard, C.B.; Silman, I.; Sussman, J.L.
Deposited on : 1999-04-21
Resolution : 2.40 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

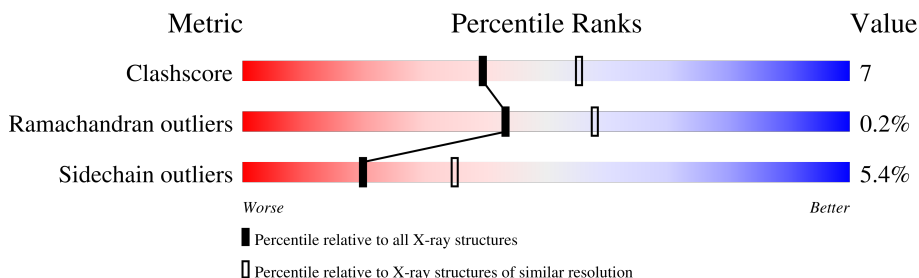
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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))
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	537	

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
2	NAG	A	9059	X	-	-	-

2 Entry composition [i](#)

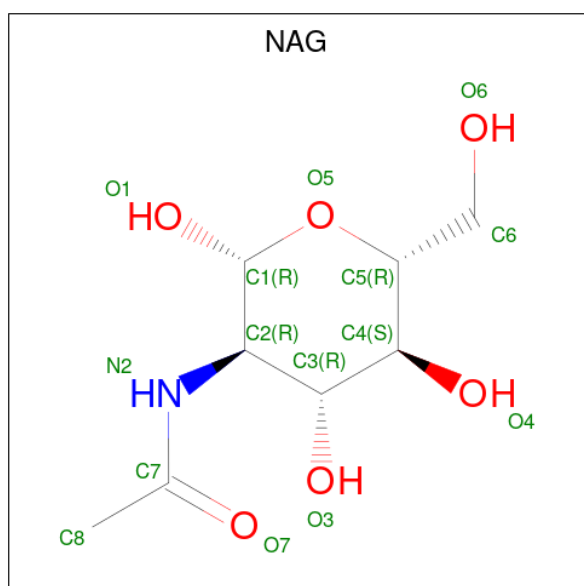
There are 4 unique types of molecules in this entry. The entry contains 4492 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 PROTEIN (ACETYLCHOLINESTERASE).

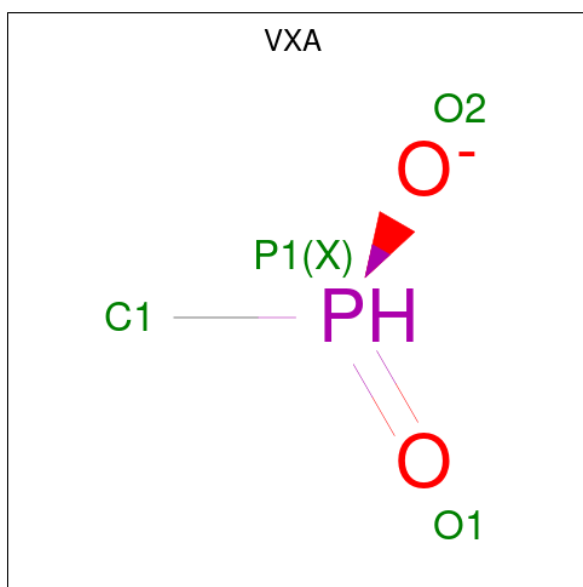
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	532	Total	C	N	O	S	0	0	0
			4244	2721	720	781	22			

- Molecule 2 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: $C_8H_{15}NO_6$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			14	8	1	5		
2	A	1	Total	C	N	O	0	0
			14	8	1	5		

- Molecule 3 is METHYLPHOSPHONIC ACID ESTER GROUP (CCD ID: VXA) (formula: CH_4O_2P).



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

- Molecule 4 is water.

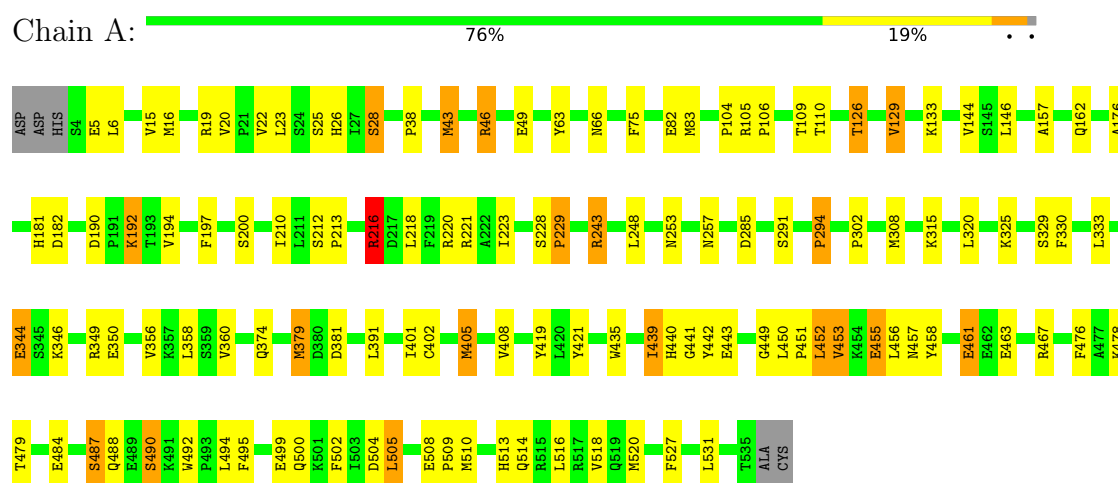
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	216	Total	O	0	0
			216	216		

3 Residue-property plots

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. 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.

Note EDS was not executed.

• Molecule 1: PROTEIN (ACETYLCHOLINESTERASE)



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	112.51Å 112.51Å 137.96Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.40	Depositor
% Data completeness (in resolution range)	97.0 (30.00-2.40)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.194 , 0.234	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4492	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

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

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	1.22	11/4367 (0.3%)	1.32	42/5929 (0.7%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	200	SER	CA-C	7.08	1.59	1.53
1	A	405	MET	SD-CE	6.31	1.95	1.79
1	A	253	ASN	CG-OD1	5.84	1.34	1.23
1	A	20	VAL	CA-C	-5.51	1.47	1.52
1	A	15	VAL	CA-CB	5.36	1.64	1.55
1	A	43	MET	SD-CE	5.29	1.92	1.79
1	A	333	LEU	CG-CD1	5.10	1.69	1.52
1	A	435	TRP	CA-C	5.09	1.59	1.52
1	A	294	PRO	CA-C	5.06	1.58	1.52
1	A	344	GLU	CD-OE1	5.04	1.34	1.25
1	A	344	GLU	CD-OE2	5.03	1.34	1.25

All (42) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	443	GLU	N-CA-C	-9.45	101.88	113.50
1	A	479	THR	N-CA-C	8.60	124.89	113.72

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	291	SER	N-CA-C	8.52	120.19	111.07
1	A	439	ILE	N-CA-C	8.38	120.95	109.80
1	A	285	ASP	N-CA-C	-8.05	96.93	109.25
1	A	527	PHE	N-CA-C	7.47	119.32	111.03
1	A	216	ARG	N-CA-C	6.93	120.62	111.75
1	A	401	ILE	N-CA-C	6.37	116.48	110.30
1	A	109	THR	N-CA-C	6.36	119.48	110.14
1	A	133	LYS	N-CA-C	6.33	118.99	111.71
1	A	75	PHE	CA-C-N	6.11	127.47	119.84
1	A	75	PHE	C-N-CA	6.11	127.47	119.84
1	A	381	ASP	N-CA-C	5.98	119.84	112.54
1	A	492	TRP	N-CA-C	-5.93	97.85	108.47
1	A	243	ARG	CG-CD-NE	-5.92	98.97	112.00
1	A	176	ALA	N-CA-C	-5.82	104.93	111.28
1	A	488	GLN	N-CA-C	-5.75	106.24	113.72
1	A	329	SER	N-CA-C	5.70	117.49	111.28
1	A	476	PHE	N-CA-C	-5.52	105.34	111.36
1	A	162	GLN	N-CA-C	-5.51	106.61	113.38
1	A	379	MET	N-CA-C	-5.50	106.24	113.17
1	A	144	VAL	CA-C-N	-5.43	115.34	122.99
1	A	144	VAL	C-N-CA	-5.43	115.34	122.99
1	A	441	GLY	N-CA-C	5.39	122.22	115.21
1	A	229	PRO	N-CA-C	5.39	120.92	113.65
1	A	157	ALA	N-CA-C	5.34	117.52	108.02
1	A	500	GLN	N-CA-C	5.32	118.77	111.54
1	A	248	LEU	N-CA-C	-5.30	105.42	111.14
1	A	449	GLY	N-CA-C	5.27	122.62	115.30
1	A	518	VAL	N-CA-C	5.26	115.98	110.62
1	A	126	THR	N-CA-C	5.26	119.79	113.17
1	A	402	CYS	CA-C-N	-5.25	113.13	118.85
1	A	402	CYS	C-N-CA	-5.25	113.13	118.85
1	A	210	ILE	N-CA-C	-5.16	104.64	111.09
1	A	218	LEU	N-CA-C	5.15	119.28	113.15
1	A	360	VAL	CA-C-N	5.13	125.42	119.47
1	A	360	VAL	C-N-CA	5.13	125.42	119.47
1	A	514	GLN	N-CA-C	5.12	117.16	109.23
1	A	257	ASN	N-CA-C	5.05	118.70	112.54
1	A	325	LYS	N-CA-C	5.04	116.86	111.36
1	A	82	GLU	N-CA-C	5.03	117.66	111.82
1	A	66	ASN	N-CA-C	-5.01	102.11	110.17

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	442	TYR	Sidechain

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	4244	0	4094	56	0
2	A	28	0	26	0	0
3	A	4	0	3	0	0
4	A	216	0	0	4	0
All	All	4492	0	4123	56	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 (56) 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:A:83:MET:HE1	4:A:1198:HOH:O	1.84	0.78
1:A:190:ASP:OD1	1:A:192:LYS:HG2	1.87	0.73
1:A:320:LEU:C	1:A:320:LEU:HD23	2.20	0.67
1:A:452:LEU:HD13	1:A:467:ARG:NH2	2.10	0.66
1:A:453:VAL:HG22	1:A:456:LEU:HG	1.77	0.65
1:A:455:GLU:CD	1:A:455:GLU:H	2.07	0.62
1:A:23:LEU:HD11	1:A:452:LEU:HD12	1.83	0.61
1:A:484:GLU:HB2	1:A:487:SER:HB2	1.81	0.61
1:A:520:MET:HE2	1:A:520:MET:HA	1.82	0.61
1:A:379:MET:HE3	4:A:1132:HOH:O	2.00	0.61
1:A:46:ARG:HH11	1:A:46:ARG:HB3	1.66	0.60
1:A:110:THR:OG1	1:A:478:LYS:HG2	2.03	0.58
1:A:302:PRO:HD2	1:A:308:MET:SD	2.45	0.56
1:A:490:SER:O	1:A:510:MET:HE1	2.06	0.56
1:A:223:ILE:HA	1:A:320:LEU:O	2.07	0.54
1:A:220:ARG:HG3	1:A:221:ARG:HG3	1.91	0.52
1:A:344:GLU:OE1	1:A:346:LYS:HE2	2.11	0.51

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:216:ARG:HB3	1:A:315:LYS:HB2	1.92	0.50
1:A:129:VAL:HG22	4:A:1054:HOH:O	2.11	0.50
1:A:228:SER:HB2	1:A:229:PRO:HD2	1.93	0.50
1:A:456:LEU:O	1:A:457:ASN:HB2	2.12	0.49
1:A:451:PRO:HA	1:A:458:TYR:CD1	2.47	0.49
1:A:25:SER:OG	1:A:26:HIS:N	2.46	0.49
1:A:520:MET:HG2	4:A:1005:HOH:O	2.12	0.48
1:A:6:LEU:CD2	1:A:28:SER:HB3	2.43	0.48
1:A:6:LEU:HD23	1:A:28:SER:HB3	1.96	0.48
1:A:43:MET:CE	1:A:49:GLU:HG2	2.44	0.48
1:A:484:GLU:HB2	1:A:487:SER:CB	2.43	0.47
1:A:461:GLU:H	1:A:461:GLU:CD	2.21	0.47
1:A:531:LEU:C	1:A:531:LEU:HD23	2.40	0.47
1:A:504:ASP:CG	1:A:513:HIS:HE2	2.23	0.46
1:A:63:TYR:CD1	1:A:126:THR:HG22	2.51	0.46
1:A:453:VAL:HG22	1:A:453:VAL:O	2.15	0.45
1:A:421:TYR:C	1:A:421:TYR:CD1	2.94	0.45
1:A:374:GLN:OE1	1:A:520:MET:HE1	2.16	0.45
1:A:508:GLU:HB3	1:A:509:PRO:CD	2.46	0.45
1:A:216:ARG:H	1:A:216:ARG:HG2	1.61	0.43
1:A:450:LEU:N	1:A:450:LEU:CD2	2.81	0.43
1:A:43:MET:HE1	1:A:49:GLU:HG2	2.01	0.43
1:A:452:LEU:HD22	1:A:463:GLU:HG3	1.99	0.43
1:A:105:ARG:HA	1:A:106:PRO:HD3	1.91	0.43
1:A:146:LEU:C	1:A:146:LEU:HD12	2.44	0.42
1:A:452:LEU:HD13	1:A:467:ARG:CZ	2.48	0.42
1:A:421:TYR:HB2	1:A:505:LEU:HD22	2.02	0.42
1:A:344:GLU:OE1	1:A:346:LYS:CE	2.68	0.42
1:A:197:PHE:HB3	1:A:223:ILE:HB	2.02	0.42
1:A:456:LEU:HD23	1:A:456:LEU:HA	1.85	0.42
1:A:439:ILE:HG22	1:A:440:HIS:N	2.36	0.41
1:A:405:MET:HA	1:A:408:VAL:HG12	2.03	0.41
1:A:419:TYR:CZ	1:A:494:LEU:HD13	2.55	0.41
1:A:181:HIS:HD2	1:A:182:ASP:OD1	2.04	0.40
1:A:5:GLU:OE2	1:A:104:PRO:HA	2.22	0.40
1:A:197:PHE:CB	1:A:223:ILE:HB	2.51	0.40
1:A:212:SER:HA	1:A:213:PRO:HD3	1.93	0.40
1:A:495:PHE:CD1	1:A:495:PHE:C	2.99	0.40
1:A:502:PHE:CE1	1:A:516:LEU:HB2	2.57	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	530/537 (99%)	502 (95%)	27 (5%)	1 (0%)	43	58

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	487	SER

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	465/469 (99%)	440 (95%)	25 (5%)	20	35

All (25) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	16	MET
1	A	19	ARG
1	A	22	VAL
1	A	28	SER
1	A	38	PRO
1	A	46	ARG
1	A	129	VAL
1	A	192	LYS
1	A	194	VAL
1	A	216	ARG

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Mol	Chain	Res	Type
1	A	243	ARG
1	A	294	PRO
1	A	330	PHE
1	A	349	ARG
1	A	350	GLU
1	A	356	VAL
1	A	358	LEU
1	A	391	LEU
1	A	452	LEU
1	A	453	VAL
1	A	455	GLU
1	A	461	GLU
1	A	490	SER
1	A	499	GLU
1	A	505	LEU

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

Mol	Chain	Res	Type
1	A	26	HIS
1	A	68	GLN
1	A	74	GLN
1	A	181	HIS

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](#)

3 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	NAG	A	9416	1	14,14,15	1.17	1 (7%)	17,19,21	0.96	1 (5%)
3	VXA	A	999	1	0,3,3	-	-	0,3,3	-	-
2	NAG	A	9059	1	14,14,15	1.67	3 (21%)	17,19,21	1.48	3 (17%)

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	NAG	A	9059	1	1/1/5/7	1/6/23/26	0/1/1/1
2	NAG	A	9416	1	-	2/6/23/26	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	9059	NAG	O5-C5	3.93	1.51	1.43
2	A	9059	NAG	C3-C2	2.60	1.58	1.52
2	A	9059	NAG	O5-C1	2.41	1.47	1.43
2	A	9416	NAG	C6-C5	2.18	1.59	1.51

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	9059	NAG	C4-C3-C2	3.09	115.54	111.02
2	A	9059	NAG	O5-C1-C2	-2.97	106.70	111.29
2	A	9059	NAG	C2-N2-C7	-2.58	119.44	122.90
2	A	9416	NAG	C3-C4-C5	2.07	113.99	110.23

All (1) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	A	9059	NAG	C1

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	9416	NAG	O5-C5-C6-O6
2	A	9416	NAG	C4-C5-C6-O6
2	A	9059	NAG	O5-C5-C6-O6

There are no ring outliers.

No monomer is involved in short contacts.

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

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.