W O R L D W I D E
wwPDB
P R O T E I N   D A T A   B A N K

Full wwPDB X-ray Structure Validation Report ⓘ

Dec 9, 2023 – 01:26 pm GMT

PDB ID	:	1E7S
Title	:	GDP 4-keto-6-deoxy-D-mannose epimerase reductase K140R
Authors	:	Rosano, C.; Zuccotti, S.; Izzo, G.; Bolognesi, M.
Deposited on	:	2000-09-07
Resolution	:	1.50 Å(reported)

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

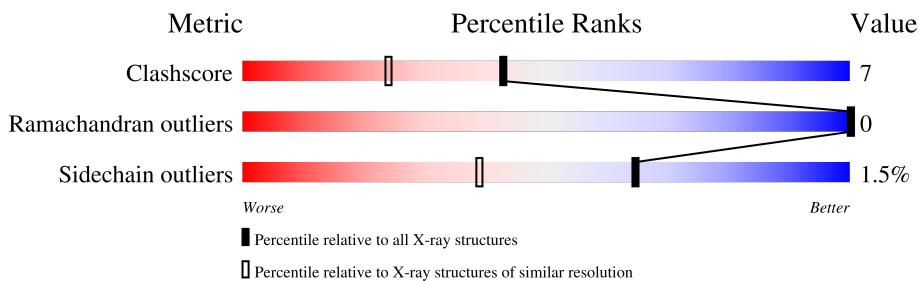|		
MolProbity	:	4.02b-467
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, 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 1.50 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	Percentile Ranks	Value
Clashscore		7
Ramachandran outliers		0
Sidechain outliers		1.5%

Worse ▬▬▬▬▬ *Better*

■ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	141614	3144 (1.50-1.50)
Ramachandran outliers	138981	3066 (1.50-1.50)
Sidechain outliers	138945	3064 (1.50-1.50)

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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	321	83% 13% • •

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
5	TRS	A	1321	-	X	-	-

2 Entry composition ⓘ

There are 6 unique types of molecules in this entry. The entry contains 2999 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 GDP-FUCOSE SYNTHETASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	314	Total 2502	C 1580	N 451	O 459	S 12	31	5	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	140	ARG	LYS	engineered mutation	UNP P37744
A	195	SER	ASN	conflict	UNP P32055

• Molecule 2 is NADP NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (three-letter code: NAP) (formula: $C_{21}H_{28}N_7O_{17}P_3$).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total 48	C 21	N 7	O 17	P 3	0	0

• Molecule 3 is ACETYLPHOSPHATE (three-letter code: UVW) (formula: $C_2H_5O_5P$).
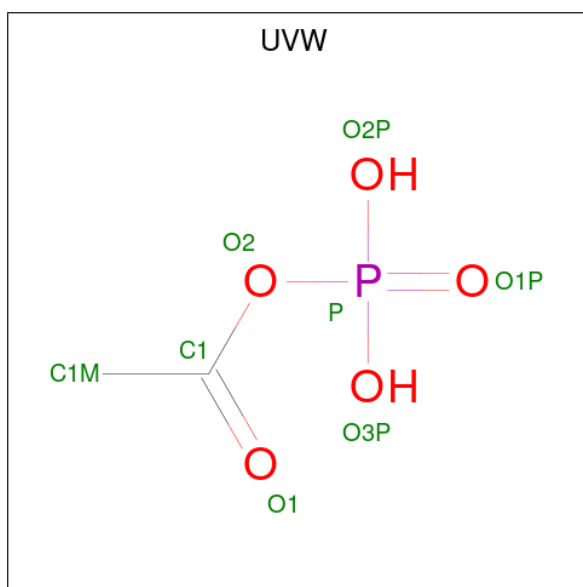
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	P	0	0
			8	2	5	1		

- Molecule 4 is SULFATE ION (three-letter code: SO4) (formula: O_4S).

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		
4	A	1	Total	O	S	0	0
			5	4	1		

- Molecule 5 is 2-AMINO-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (three-letter code: TRS) (formula: $C_4H_{12}NO_3$).
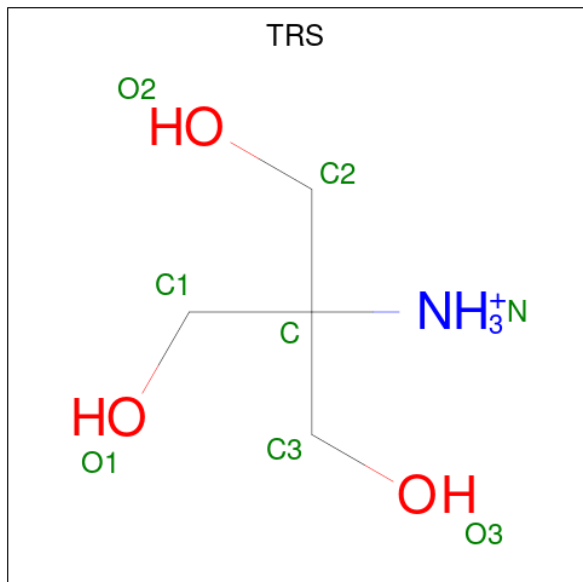
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
5	A	1	Total	C	N	O	0	0
			8	4	1	3		

- Molecule 6 is water.

| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	418	Total	O	0	0
			418	418		

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. 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: GDP-FUCOSE SYNTHETASE

Chain A:
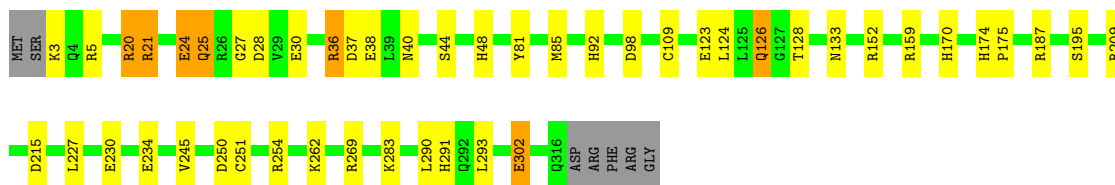
4 Data and refinement statistics (i)

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

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α, β, γ	103.40Å 103.40Å 75.40Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	12.00 – 1.50	Depositor
% Data completeness (in resolution range)	98.7 (12.00-1.50)	Depositor
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC	Depositor
R, R_{free}	0.126 , 0.162	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	2999	wwPDB-VP
Average B, all atoms (Å^2)	27.0	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: TRS, SO4, UVW, NAP

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	0.92	7/2585 (0.3%)	1.22	25/3508 (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	4

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	234	GLU	CB-CG	-24.81	1.05	1.52
1	A	30	GLU	CG-CD	-14.46	1.30	1.51
1	A	25	GLN	CG-CD	11.22	1.76	1.51
1	A	230	GLU	CG-CD	-6.39	1.42	1.51
1	A	195	SER	CB-OG	5.81	1.49	1.42
1	A	109	CYS	CA-CB	5.31	1.65	1.53
1	A	302	GLU	CD-OE2	5.25	1.31	1.25

All (25) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	36	ARG	NE-CZ-NH1	-11.12	114.74	120.30
1	A	109	CYS	CA-CB-SG	-8.62	98.48	114.00
1	A	98	ASP	CB-CG-OD1	-8.37	110.77	118.30
1	A	195	SER	N-CA-CB	8.36	123.05	110.50
1	A	38	GLU	OE1-CD-OE2	-7.75	114.00	123.30
1	A	98	ASP	CB-CG-OD2	-7.71	111.36	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	98	ASP	OD1-CG-OD2	7.51	137.57	123.30
1	A	250	ASP	CB-CA-C	-7.46	95.47	110.40
1	A	20[A]	ARG	NE-CZ-NH1	-7.28	116.66	120.30
1	A	20[B]	ARG	NE-CZ-NH1	-7.28	116.66	120.30
1	A	152	ARG	NE-CZ-NH1	6.96	123.78	120.30
1	A	24	GLU	CA-CB-CG	6.90	128.58	113.40
1	A	30	GLU	CB-CG-CD	-6.43	96.85	114.20
1	A	30	GLU	CG-CD-OE1	6.39	131.09	118.30
1	A	5	ARG	NE-CZ-NH2	-6.05	117.28	120.30
1	A	152	ARG	NE-CZ-NH2	-5.95	117.33	120.30
1	A	30	GLU	CG-CD-OE2	-5.93	106.44	118.30
1	A	5	ARG	CD-NE-CZ	5.78	131.69	123.60
1	A	269	ARG	NE-CZ-NH1	5.69	123.15	120.30
1	A	21	ARG	NE-CZ-NH2	-5.63	117.48	120.30
1	A	215	ASP	CB-CG-OD2	5.52	123.27	118.30
1	A	5	ARG	NE-CZ-NH1	5.44	123.02	120.30
1	A	159	ARG	NE-CZ-NH2	-5.40	117.60	120.30
1	A	128	THR	CA-CB-OG1	-5.39	97.69	109.00
1	A	209	ARG	NE-CZ-NH1	5.07	122.83	120.30

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	123	GLU	Sidechain
1	A	126	GLN	Sidechain
1	A	25	GLN	Mainchain
1	A	28	ASP	Mainchain

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	2502	0	2468	29	0
2	A	48	0	25	1	0
3	A	8	0	3	3	0
4	A	15	0	0	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	A	8	0	12	5	0
6	A	418	0	0	12	7
All	All	2999	0	2508	34	7

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 (34) 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:254:ARG:NH2	6:A:2310:HOH:O	1.64	1.12
3:A:1318:UVW:O3P	3:A:1318:UVW:C1M	1.88	1.10
3:A:1318:UVW:O3P	3:A:1318:UVW:H1M1	1.22	1.09
1:A:48:HIS:CE1	1:A:92:HIS:HD2	1.79	0.98
1:A:48:HIS:HE1	1:A:92:HIS:CD2	1.86	0.91
1:A:48:HIS:HE1	1:A:92:HIS:HD2	0.94	0.87
1:A:283:LYS:NZ	4:A:1322:SO4:O4	2.10	0.84
1:A:24:GLU:HG2	6:A:2026:HOH:O	1.88	0.74
1:A:48:HIS:CE1	1:A:92:HIS:CD2	2.71	0.70
1:A:302:GLU:OE1	6:A:2378:HOH:O	2.09	0.70
1:A:170:HIS:NE2	5:A:1321:TRS:H32	2.11	0.66
1:A:21:ARG:HD3	5:A:1321:TRS:H31	1.87	0.56
1:A:291:HIS:HE1	6:A:2372:HOH:O	1.89	0.56
1:A:124:LEU:HD23	6:A:2205:HOH:O	2.05	0.56
3:A:1318:UVW:O3P	3:A:1318:UVW:H1M3	2.00	0.56
1:A:227:LEU:HD13	1:A:293:LEU:HD22	1.87	0.55
1:A:20[B]:ARG:HE	1:A:24:GLU:CD	2.10	0.54
1:A:3:LYS:HE2	1:A:27:GLY:O	2.09	0.53
1:A:170:HIS:CD2	5:A:1321:TRS:H32	2.45	0.52
5:A:1321:TRS:O3	6:A:2414:HOH:O	2.18	0.51
1:A:291:HIS:HD2	6:A:2158:HOH:O	1.94	0.51
1:A:36:ARG:NH2	6:A:2040:HOH:O	2.21	0.50
1:A:44:SER:O	1:A:48:HIS:HD2	1.93	0.50
1:A:81:TYR:CZ	1:A:85:MET:HG3	2.46	0.50
1:A:262[B]:LYS:HE3	1:A:302:GLU:OE2	2.13	0.49
1:A:174:HIS:CG	1:A:175:PRO:HD2	2.50	0.47
2:A:1317:NAP:H2N	6:A:2236:HOH:O	2.15	0.46
1:A:24:GLU:CG	6:A:2026:HOH:O	2.57	0.45
1:A:20[B]:ARG:HG2	1:A:24:GLU:HG3	1.99	0.43
1:A:245:VAL:HA	1:A:290:LEU:HD22	2.02	0.41
1:A:170:HIS:NE2	5:A:1321:TRS:C3	2.79	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:187:ARG:NH1	6:A:2251:HOH:O	2.46	0.41
1:A:92:HIS:HE1	6:A:2140:HOH:O	2.05	0.40

All (7) 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	Interatomic distance (Å)	Clash overlap (Å)
6:A:2188:HOH:O	6:A:2188:HOH:O[5_555]	0.75	1.45
6:A:2132:HOH:O	6:A:2132:HOH:O[5_555]	0.82	1.38
6:A:2202:HOH:O	6:A:2206:HOH:O[5_555]	1.97	0.23
6:A:2143:HOH:O	6:A:2345:HOH:O[3_665]	2.05	0.15
6:A:2242:HOH:O	6:A:2380:HOH:O[2_654]	2.07	0.13
6:A:2210:HOH:O	6:A:2269:HOH:O[6_655]	2.16	0.04
6:A:2003:HOH:O	6:A:2260:HOH:O[6_655]	2.18	0.02

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	317/321 (99%)	311 (98%)	6 (2%)	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	270/271 (100%)	266 (98%)	4 (2%)	65 39

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

Mol	Chain	Res	Type
1	A	37	ASP
1	A	40	ASN
1	A	126	GLN
1	A	251	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	40	ASN
1	A	48	HIS
1	A	92	HIS
1	A	117	GLN
1	A	126	GLN
1	A	172	ASN
1	A	237	GLN
1	A	242	HIS
1	A	291	HIS
1	A	315	ASN

5.3.3 RNA ⓘ

There are no RNA molecules 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 monosaccharides in this entry.

5.6 Ligand geometry ⓘ

6 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	$\#|Z| > 2$
4	SO4	A	1322	-	4,4,4	0.51	0	6,6,6	0.49	0
5	TRS	A	1321	-	7,7,7	1.81	1 (14%)	9,9,9	5.74	5 (55%)
4	SO4	A	1320	-	4,4,4	0.69	0	6,6,6	1.35	2 (33%)
3	UVW	A	1318	-	6,7,7	4.13	3 (50%)	7,10,10	1.80	1 (14%)
2	NAP	A	1317	-	45,52,52	1.54	7 (15%)	56,80,80	1.39	7 (12%)
4	SO4	A	1319	-	4,4,4	0.70	0	6,6,6	0.28	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	NAP	A	1317	-	-	2/31/67/67	0/5/5/5
5	TRS	A	1321	-	-	7/9/9/9	-
3	UVW	A	1318	-	-	0/3/5/5	-

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1318	UVW	P-O2	-7.02	1.48	1.59
3	A	1318	UVW	C1M-C1	-6.52	1.27	1.49
2	A	1317	NAP	C2N-N1N	4.44	1.40	1.35
5	A	1321	TRS	O1-C1	3.75	1.54	1.42
2	A	1317	NAP	C7N-N7N	3.53	1.39	1.33
2	A	1317	NAP	C3N-C7N	3.29	1.55	1.50
2	A	1317	NAP	C2D-C1D	-3.08	1.49	1.53
2	A	1317	NAP	C5N-C4N	2.61	1.44	1.38
3	A	1318	UVW	P-O2P	-2.38	1.45	1.54
2	A	1317	NAP	C2A-N3A	2.23	1.35	1.32
2	A	1317	NAP	P2B-O3X	-2.03	1.47	1.54

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	A	1321	TRS	C1-C-N	11.75	143.05	107.98
5	A	1321	TRS	O1-C1-C	9.69	141.70	111.00
5	A	1321	TRS	C2-C-N	-6.25	89.31	107.98
5	A	1321	TRS	C3-C-N	-4.21	95.42	107.98
3	A	1318	UVW	O3P-P-O2	3.83	116.94	105.25
2	A	1317	NAP	C2D-C3D-C4D	-3.76	95.33	102.64
2	A	1317	NAP	O7N-C7N-N7N	3.36	127.35	122.58
2	A	1317	NAP	O3D-C3D-C4D	-2.92	102.61	111.05
2	A	1317	NAP	C3D-C2D-C1D	-2.62	97.04	100.98
2	A	1317	NAP	O7N-C7N-C3N	-2.62	116.50	119.63
5	A	1321	TRS	C2-C-C1	-2.54	102.94	110.81
2	A	1317	NAP	O4D-C4D-C3D	-2.54	100.09	105.11
4	A	1320	SO4	O2-S-O1	2.25	126.05	109.43
2	A	1317	NAP	O3D-C3D-C2D	-2.03	105.26	111.82
4	A	1320	SO4	O4-S-O3	-2.03	100.41	109.06

There are no chirality outliers.

All (9) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	1321	TRS	C2-C-C1-O1
5	A	1321	TRS	C3-C-C1-O1
5	A	1321	TRS	C3-C-C2-O2
5	A	1321	TRS	C2-C-C3-O3
5	A	1321	TRS	N-C-C1-O1
5	A	1321	TRS	C1-C-C2-O2
5	A	1321	TRS	C1-C-C3-O3
2	A	1317	NAP	O4B-C4B-C5B-O5B
2	A	1317	NAP	C5D-O5D-PN-O1N

There are no ring outliers.

4 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	1322	SO4	1	0
5	A	1321	TRS	5	0
3	A	1318	UVW	3	0
2	A	1317	NAP	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will

also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand NAP A 1317

Bond lengths · Bond angles · Torsions · Rings
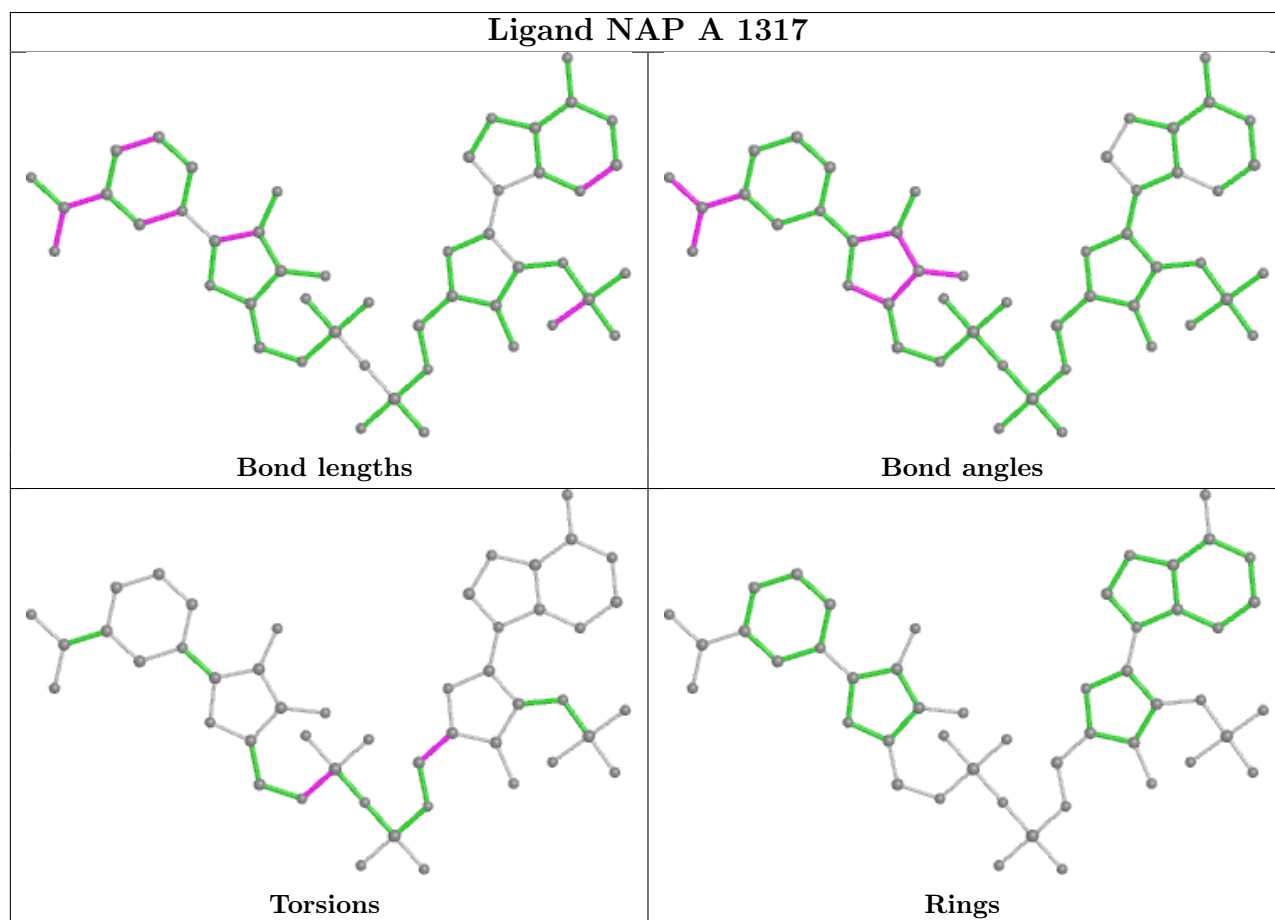
5.7 Other polymers (i)

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 ⓘ

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.