



# Full wwPDB X-ray Structure Validation Report ⓘ

Oct 26, 2023 – 03:33 AM EDT

PDB ID : 2ZTM  
Title : T190S mutant of D-3-hydroxybutyrate dehydrogenase  
Authors : Nakashima, K.; Nakajima, Y.; Ito, K.; Yoshimoto, T.  
Deposited on : 2008-10-07  
Resolution : 2.30 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  
buster-report : 1.1.7 (2018)  
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

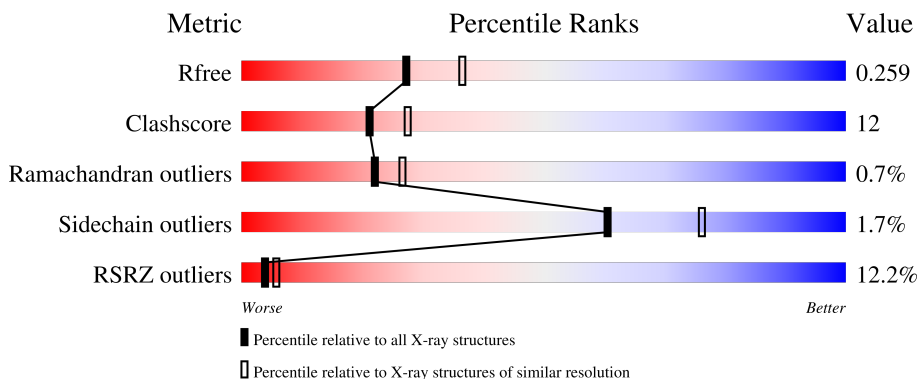
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 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	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (2.30-2.30)

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	260	 9% 80% 18%
1	B	260	 25% 54% 30% 14%
1	C	260	 5% 81% 15%
1	D	260	 6% 78% 16% 5%

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 7551 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 D(-)-3-hydroxybutyrate dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	255	Total 1840	C 1155	N 327	O 355	S 3	0	0	0
1	B	224	Total 1598	C 1006	N 286	O 303	S 3	0	0	0
1	C	250	Total 1793	C 1131	N 317	O 341	S 4	0	0	0
1	D	247	Total 1771	C 1117	N 314	O 336	S 4	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	190	SER	THR	engineered mutation	UNP Q5KST5
B	190	SER	THR	engineered mutation	UNP Q5KST5
C	190	SER	THR	engineered mutation	UNP Q5KST5
D	190	SER	THR	engineered mutation	UNP Q5KST5

- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: C<sub>21</sub>H<sub>27</sub>N<sub>7</sub>O<sub>14</sub>P<sub>2</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total C O 7 4 3	0	0

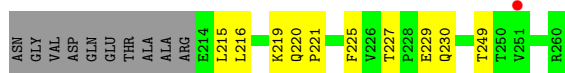
- Molecule 4 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total Mg 1 1	0	0
4	B	1	Total Mg 1 1	0	0

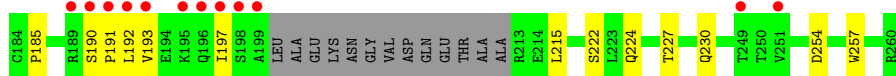
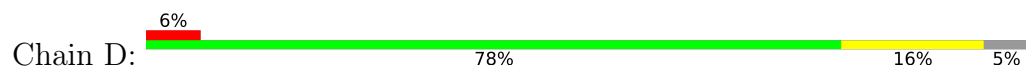
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	106	Total O 106 106	0	0
5	B	54	Total O 54 54	0	0
5	C	141	Total O 141 141	0	0
5	D	107	Total O 107 107	0	0





● Molecule 1: D(-)-3-hydroxybutyrate dehydrogenase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	73.79Å 105.93Å 164.50Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.30 48.76 – 2.29	Depositor EDS
% Data completeness (in resolution range)	99.9 (20.00-2.30) 99.5 (48.76-2.29)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.94 (at 2.29Å)	Xtrriage
Refinement program	CNS	Depositor
R, $R_{free}$	0.227 , 0.266 0.223 , 0.259	Depositor DCC
$R_{free}$ test set	2950 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	36.5	Xtrriage
Anisotropy	0.370	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 46.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	7551	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	42.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.76% 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: MG, 3HL, NAD

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	0.33	0/1866	0.59	0/2534
1	B	0.31	0/1621	0.55	0/2202
1	C	0.36	0/1818	0.60	0/2467
1	D	0.34	0/1796	0.59	0/2437
All	All	0.34	0/7101	0.59	0/9640

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 [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 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	1840	0	1863	34	0
1	B	1598	0	1601	83	0
1	C	1793	0	1822	28	0
1	D	1771	0	1800	39	0
2	A	44	0	26	3	0
2	C	44	0	26	3	0
2	D	44	0	26	5	0
3	A	7	0	7	0	0
4	A	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	1	0	0	0	0
5	A	106	0	0	1	0
5	B	54	0	0	5	0
5	C	141	0	0	2	0
5	D	107	0	0	1	0
All	All	7551	0	7171	173	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 12.

All (173) 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:188:VAL:HG12	1:B:189:ARG:H	1.34	0.90
1:B:34:ASN:HD21	1:B:64:LEU:HD11	1.35	0.89
1:C:84:ILE:H	1:C:132:GLN:HE22	1.24	0.85
1:B:59:TYR:HD2	1:B:60:ASP:N	1.76	0.83
1:B:216:LEU:HD11	1:B:225:PHE:CE1	2.14	0.83
1:A:206:VAL:HG12	1:A:207:ASP:H	1.45	0.81
1:B:76:ASN:HA	1:B:79:ARG:HE	1.46	0.81
1:B:64:LEU:H	1:B:64:LEU:HD12	1.45	0.80
1:B:83:ARG:HA	5:B:1395:HOH:O	1.86	0.75
1:B:128:HIS:O	1:B:132:GLN:HG3	1.87	0.74
1:B:98:LEU:HD23	1:B:151:ASN:ND2	2.07	0.70
1:C:194:GLU:HA	1:C:197:ILE:HD12	1.74	0.69
1:C:10:THR:HB	1:C:64:LEU:HD11	1.75	0.69
1:B:29:ALA:O	1:B:31:ILE:HD12	1.94	0.68
1:B:78:VAL:HG21	1:B:128:HIS:CD2	2.28	0.68
1:B:232:GLY:O	1:B:236:VAL:HG23	1.93	0.68
1:B:56:LYS:HG2	1:B:58:LEU:HD11	1.74	0.68
1:B:188:VAL:HG12	1:B:189:ARG:N	2.08	0.67
1:A:58:LEU:HD22	1:A:81:MET:HE3	1.77	0.66
1:B:9:VAL:HG12	1:B:12:SER:HB3	1.78	0.66
1:D:185:PRO:HG2	2:D:300:NAD:C5N	2.25	0.66
1:B:27:GLN:HG2	5:B:1360:HOH:O	1.96	0.65
1:A:152:LYS:O	1:A:156:VAL:HG23	1.98	0.64
1:B:93:ILE:HD13	1:B:93:ILE:H	1.62	0.64
1:A:206:VAL:HG12	1:A:207:ASP:N	2.13	0.64
1:D:197:ILE:HG12	1:D:215:LEU:HD13	1.80	0.63
1:D:64:LEU:HD22	1:D:70:VAL:HG22	1.81	0.63
1:A:206:VAL:HG11	1:A:210:THR:HG21	1.82	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:93:ILE:HG13	1:C:110:ILE:HD13	1.81	0.62
1:C:192:LEU:HD23	1:C:192:LEU:O	2.00	0.62
1:B:95:HIS:CD2	1:B:106:LYS:HG3	2.35	0.62
1:B:76:ASN:HA	1:B:79:ARG:NE	2.15	0.61
1:B:30:ASP:HB3	1:B:81:MET:HE1	1.81	0.61
1:B:167:LYS:HE2	5:B:1405:HOH:O	1.99	0.61
1:C:193:VAL:O	1:C:197:ILE:HG13	2.01	0.61
1:B:16:ILE:HD11	1:B:188:VAL:HG21	1.82	0.60
1:B:110:ILE:O	1:B:114:ASN:HB2	2.02	0.60
1:A:165:PHE:CE1	1:C:153:SER:HB2	2.36	0.59
1:B:56:LYS:HG2	1:B:58:LEU:CD1	2.33	0.59
1:D:185:PRO:HG2	2:D:300:NAD:H5N	1.84	0.58
1:B:172:GLU:OE1	1:D:99:ILE:HG13	2.04	0.58
1:B:71:ARG:HE	1:B:120:HIS:HD2	1.51	0.58
1:A:130:LYS:HD2	5:C:1273:HOH:O	2.04	0.57
1:B:59:TYR:CD2	1:B:60:ASP:N	2.67	0.57
1:C:1:MET:HG2	5:C:1359:HOH:O	2.03	0.57
1:B:183:ILE:O	1:B:185:PRO:HD3	2.04	0.57
1:D:193:VAL:O	1:D:197:ILE:HG13	2.06	0.56
1:C:227:THR:OG1	1:C:230:GLN:HG3	2.05	0.55
1:A:76:ASN:HB3	5:A:1406:HOH:O	2.07	0.55
1:B:25:ALA:HA	1:B:31:ILE:HD11	1.88	0.54
1:C:10:THR:HB	1:C:64:LEU:CD1	2.37	0.54
1:D:10:THR:HB	1:D:64:LEU:CD1	2.38	0.54
1:B:84:ILE:O	1:B:84:ILE:HG23	2.08	0.54
1:B:77:ALA:O	1:B:81:MET:HB2	2.08	0.54
1:B:9:VAL:CG1	1:B:12:SER:HB3	2.38	0.53
1:B:7:ALA:HA	1:B:86:ILE:O	2.09	0.53
1:B:71:ARG:HE	1:B:120:HIS:CD2	2.28	0.52
1:D:95:HIS:CD2	1:D:106:LYS:HG3	2.44	0.52
1:C:185:PRO:HB2	2:C:300:NAD:H5N	1.92	0.52
1:A:41:GLU:O	1:A:45:VAL:HG23	2.10	0.52
1:A:226:VAL:HG21	1:A:253:VAL:O	2.10	0.52
1:B:110:ILE:HD12	1:B:154:ALA:HB3	1.91	0.52
1:C:106:LYS:O	1:C:110:ILE:HG12	2.10	0.51
1:B:11:GLY:H	1:B:34:ASN:HD22	1.59	0.51
1:B:233:GLY:O	1:B:236:VAL:HB	2.10	0.51
1:D:122:THR:HG23	1:D:137:ILE:HD13	1.93	0.50
1:A:64:LEU:HD22	1:A:70:VAL:HG22	1.92	0.50
1:B:213:ARG:HB2	1:B:213:ARG:NH1	2.26	0.50
1:B:187:TRP:HA	1:B:187:TRP:CE3	2.46	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:241:ASP:HB2	5:B:1163:HOH:O	2.10	0.50
1:D:96:THR:O	1:D:97:ALA:HB2	2.12	0.50
1:B:64:LEU:HB3	1:B:70:VAL:HG22	1.94	0.50
1:D:215:LEU:HD23	1:D:215:LEU:O	2.12	0.49
1:D:222:SER:O	1:D:224:GLN:HG3	2.12	0.49
1:B:91:ALA:HB3	5:B:1397:HOH:O	2.12	0.49
1:B:168:VAL:HG22	1:D:148:ALA:HB1	1.95	0.49
1:C:215:LEU:HD12	1:C:215:LEU:O	2.12	0.49
1:A:46:ARG:HG2	1:A:46:ARG:HH11	1.78	0.48
1:A:110:ILE:O	1:A:114:ASN:HB2	2.12	0.48
1:C:76:ASN:ND2	1:C:80:GLN:OE1	2.46	0.48
1:A:38:ASP:O	1:A:42:ILE:HG13	2.13	0.48
1:D:76:ASN:O	1:D:80:GLN:HG2	2.12	0.48
1:B:73:LEU:O	1:B:73:LEU:HD12	2.13	0.48
1:D:84:ILE:HG23	1:D:84:ILE:O	2.14	0.48
1:C:84:ILE:O	1:C:84:ILE:HG23	2.13	0.48
1:C:189:ARG:HE	1:C:194:GLU:HG2	1.79	0.48
1:D:110:ILE:O	1:D:114:ASN:HB2	2.14	0.48
1:D:64:LEU:CD2	1:D:70:VAL:HG22	2.43	0.47
1:B:31:ILE:HD12	1:B:31:ILE:N	2.29	0.47
1:B:60:ASP:HB3	1:B:73:LEU:HD13	1.96	0.47
1:B:22:THR:O	1:B:25:ALA:HB3	2.13	0.47
1:B:93:ILE:HD13	1:B:93:ILE:N	2.30	0.47
1:B:254:ASP:HB2	1:B:257:TRP:HB2	1.96	0.46
1:A:84:ILE:HG23	1:A:84:ILE:O	2.15	0.46
1:A:188:VAL:HG22	1:A:226:VAL:HB	1.96	0.46
1:A:206:VAL:HG11	1:A:210:THR:CG2	2.44	0.46
1:A:191:PRO:HD2	2:A:300:NAD:O2A	2.16	0.46
1:B:188:VAL:O	1:B:225:PHE:HD2	1.99	0.46
1:B:30:ASP:HB3	1:B:81:MET:CE	2.46	0.46
1:B:58:LEU:HD12	1:B:58:LEU:N	2.31	0.46
1:B:227:THR:OG1	1:B:230:GLN:HG3	2.16	0.46
1:A:219:LYS:HB3	1:A:257:TRP:CE2	2.51	0.46
1:B:187:TRP:HA	1:B:187:TRP:HE3	1.81	0.46
1:B:165:PHE:HE1	1:D:153:SER:HB2	1.81	0.46
1:B:98:LEU:HD23	1:B:151:ASN:HD21	1.80	0.45
1:B:168:VAL:CG2	1:D:148:ALA:HB1	2.46	0.45
1:B:87:LEU:HD22	1:B:125:ALA:HB2	1.99	0.45
1:D:38:ASP:HB3	1:D:41:GLU:HB2	1.97	0.45
1:D:10:THR:HB	1:D:64:LEU:HD11	1.98	0.45
1:A:221:PRO:HD2	1:A:255:GLY:O	2.17	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:7:ALA:HB2	1:B:86:ILE:HB	1.98	0.45
1:C:46:ARG:HG3	1:C:57:VAL:HG12	1.98	0.45
1:D:190:SER:HB2	1:D:191:PRO:HD2	1.99	0.45
1:D:141:ALA:O	2:D:300:NAD:H6N	2.17	0.45
1:B:64:LEU:H	1:B:64:LEU:CD1	2.22	0.45
1:B:50:ALA:HB2	1:B:57:VAL:HB	1.99	0.45
1:C:122:THR:O	1:C:126:LEU:HG	2.17	0.45
1:A:31:ILE:O	1:A:57:VAL:HA	2.16	0.44
1:B:59:TYR:CD2	1:B:59:TYR:C	2.89	0.44
1:B:169:THR:HA	1:D:99:ILE:HD11	1.98	0.44
1:A:128:HIS:O	1:A:132:GLN:HG2	2.17	0.44
1:B:229:GLU:OE1	1:B:229:GLU:N	2.51	0.44
1:C:141:ALA:O	2:C:300:NAD:H6N	2.18	0.44
1:A:186:GLY:O	2:A:300:NAD:H4N	2.17	0.44
1:D:130:LYS:HE2	1:D:173:THR:HG22	1.99	0.44
1:D:111:LEU:HD23	1:D:111:LEU:O	2.18	0.44
1:B:59:TYR:HD2	1:B:60:ASP:H	1.61	0.44
1:B:64:LEU:C	1:B:66:LYS:H	2.21	0.43
1:B:135:GLY:HA3	1:B:178:ILE:HG23	2.00	0.43
1:B:25:ALA:CA	1:B:31:ILE:HD11	2.49	0.43
1:B:165:PHE:CE1	1:D:153:SER:HB2	2.53	0.43
1:C:216:LEU:HD21	1:C:225:PHE:CE2	2.53	0.43
1:B:137:ILE:O	1:B:180:ALA:HA	2.19	0.43
1:A:192:LEU:HD23	1:A:192:LEU:O	2.19	0.43
1:B:188:VAL:O	1:B:225:PHE:CD2	2.71	0.43
1:D:254:ASP:HB2	1:D:257:TRP:HB3	2.01	0.43
1:A:219:LYS:O	1:A:221:PRO:HD3	2.18	0.43
1:B:159:LYS:HD3	1:B:159:LYS:HA	1.83	0.43
1:D:9:VAL:HG12	1:D:12:SER:HB3	2.01	0.42
1:A:46:ARG:HG2	1:A:46:ARG:NH1	2.34	0.42
1:B:31:ILE:HD12	1:B:31:ILE:H	1.83	0.42
1:C:229:GLU:H	1:C:229:GLU:CD	2.22	0.42
1:A:168:VAL:HG22	1:C:148:ALA:HB1	2.02	0.42
1:B:188:VAL:HG13	1:B:226:VAL:O	2.20	0.42
1:A:254:ASP:HB2	1:A:257:TRP:CB	2.49	0.42
1:B:143:ALA:O	1:B:147:VAL:HG22	2.19	0.42
1:C:142:SER:HB2	2:C:300:NAD:H6N	2.00	0.42
1:A:139:ASN:O	1:A:182:ALA:HA	2.20	0.42
1:B:34:ASN:ND2	1:B:64:LEU:HD11	2.18	0.42
1:B:111:LEU:HD23	1:D:111:LEU:HD21	2.02	0.42
1:D:96:THR:HA	1:D:151:ASN:O	2.20	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:192:LEU:O	1:D:192:LEU:HD23	2.19	0.42
1:B:84:ILE:H	1:B:132:GLN:HE22	1.68	0.41
1:A:193:VAL:O	1:A:197:ILE:HG13	2.20	0.41
1:D:130:LYS:NZ	5:D:1288:HOH:O	2.50	0.41
1:D:227:THR:OG1	1:D:230:GLN:HG3	2.20	0.41
1:C:219:LYS:O	1:C:221:PRO:HD3	2.21	0.41
1:D:111:LEU:HD21	1:D:115:LEU:HD23	2.02	0.41
1:D:183:ILE:HG22	1:D:185:PRO:HD3	2.03	0.41
1:A:89:ASN:HB2	1:A:139:ASN:HD22	1.86	0.41
1:B:182:ALA:HB3	1:B:250:THR:HG22	2.03	0.41
1:C:110:ILE:O	1:C:114:ASN:HB2	2.20	0.41
1:C:144:HIS:HA	1:C:147:VAL:O	2.21	0.41
1:B:7:ALA:CB	1:B:86:ILE:HB	2.51	0.41
1:B:13:THR:HG21	1:B:36:PHE:O	2.21	0.41
1:A:10:THR:HB	1:A:64:LEU:CD1	2.50	0.40
1:B:172:GLU:CD	1:D:99:ILE:HG13	2.41	0.40
1:C:190:SER:HB2	1:C:191:PRO:CD	2.51	0.40
1:D:90:ASN:OD1	2:D:300:NAD:H4D	2.22	0.40
1:A:153:SER:HB2	1:C:165:PHE:CE1	2.56	0.40
1:A:185:PRO:HB2	2:A:300:NAD:C5N	2.52	0.40
1:B:10:THR:HA	1:B:34:ASN:HB3	2.02	0.40
1:D:185:PRO:O	2:D:300:NAD:H5N	2.21	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	253/260 (97%)	237 (94%)	14 (6%)	2 (1%)	19	23
1	B	218/260 (84%)	198 (91%)	17 (8%)	3 (1%)	11	11
1	C	246/260 (95%)	236 (96%)	9 (4%)	1 (0%)	34	42

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	D	243/260 (94%)	233 (96%)	9 (4%)	1 (0%)	34	42
All	All	960/1040 (92%)	904 (94%)	49 (5%)	7 (1%)	22	26

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	141	ALA
1	D	97	ALA
1	A	141	ALA
1	B	15	GLY
1	C	142	SER
1	A	189	ARG
1	B	188	VAL

### 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	183/187 (98%)	181 (99%)	2 (1%)	73	86
1	B	156/187 (83%)	149 (96%)	7 (4%)	27	39
1	C	177/187 (95%)	175 (99%)	2 (1%)	73	86
1	D	175/187 (94%)	174 (99%)	1 (1%)	86	94
All	All	691/748 (92%)	679 (98%)	12 (2%)	60	76

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	220	GLN
1	A	229	GLU
1	B	59	TYR
1	B	64	LEU
1	B	76	ASN
1	B	93	ILE
1	B	187	TRP

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Mol	Chain	Res	Type
1	B	220	GLN
1	B	241	ASP
1	C	220	GLN
1	C	249	THR
1	D	101	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (18) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	52	GLN
1	A	89	ASN
1	A	139	ASN
1	A	204	ASN
1	B	34	ASN
1	B	89	ASN
1	B	95	HIS
1	B	120	HIS
1	B	132	GLN
1	B	139	ASN
1	B	151	ASN
1	C	89	ASN
1	C	132	GLN
1	C	139	ASN
1	D	89	ASN
1	D	95	HIS
1	D	132	GLN
1	D	139	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 monosaccharides in this entry.



## 5.6 Ligand geometry

Of 6 ligands modelled in this entry, 2 are monoatomic - leaving 4 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
2	NAD	D	300	-	42,48,48	2.62	11 (26%)	50,73,73	1.87	8 (16%)
2	NAD	C	300	-	42,48,48	2.65	11 (26%)	50,73,73	1.90	9 (18%)
3	3HL	A	301	-	6,6,6	0.96	0	6,7,7	1.19	0
2	NAD	A	300	-	42,48,48	2.65	11 (26%)	50,73,73	1.80	10 (20%)

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	NAD	D	300	-	-	6/26/62/62	0/5/5/5
2	NAD	C	300	-	-	9/26/62/62	0/5/5/5
3	3HL	A	301	-	-	2/4/4/4	-
2	NAD	A	300	-	-	13/26/62/62	0/5/5/5

All (33) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	300	NAD	C2N-N1N	8.85	1.45	1.35
2	A	300	NAD	C2N-N1N	8.81	1.45	1.35
2	D	300	NAD	C2N-N1N	8.65	1.45	1.35
2	C	300	NAD	C4N-C3N	8.28	1.53	1.39
2	D	300	NAD	C4N-C3N	8.15	1.53	1.39
2	A	300	NAD	C4N-C3N	8.09	1.53	1.39
2	A	300	NAD	C5N-C4N	6.30	1.52	1.38
2	D	300	NAD	C5N-C4N	6.00	1.51	1.38
2	C	300	NAD	C5N-C4N	5.96	1.51	1.38
2	A	300	NAD	C2A-N3A	5.16	1.40	1.32
2	D	300	NAD	C2A-N3A	5.14	1.40	1.32

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	300	NAD	C2A-N3A	5.02	1.40	1.32
2	D	300	NAD	C4A-N3A	3.94	1.41	1.35
2	A	300	NAD	C4A-N3A	3.84	1.40	1.35
2	C	300	NAD	C4A-N3A	3.71	1.40	1.35
2	A	300	NAD	C6N-N1N	3.15	1.43	1.35
2	D	300	NAD	C6N-N1N	3.14	1.43	1.35
2	C	300	NAD	C6N-N1N	3.08	1.42	1.35
2	A	300	NAD	C2N-C3N	-2.93	1.34	1.39
2	D	300	NAD	C2D-C1D	2.91	1.58	1.53
2	C	300	NAD	C2D-C1D	2.80	1.58	1.53
2	C	300	NAD	C2N-C3N	-2.68	1.34	1.39
2	C	300	NAD	O4D-C1D	2.52	1.44	1.41
2	D	300	NAD	C2N-C3N	-2.52	1.35	1.39
2	A	300	NAD	C2D-C1D	2.47	1.57	1.53
2	D	300	NAD	O4D-C1D	2.37	1.44	1.41
2	C	300	NAD	C3D-C4D	2.36	1.59	1.53
2	A	300	NAD	O4D-C1D	2.32	1.44	1.41
2	C	300	NAD	O2B-C2B	-2.27	1.37	1.43
2	A	300	NAD	O4D-C4D	2.26	1.50	1.45
2	D	300	NAD	O4D-C4D	2.18	1.49	1.45
2	A	300	NAD	C3D-C4D	2.12	1.58	1.53
2	D	300	NAD	C3D-C4D	2.01	1.58	1.53

All (27) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	300	NAD	C5N-C4N-C3N	-8.40	110.41	120.34
2	D	300	NAD	C5N-C4N-C3N	-8.11	110.74	120.34
2	A	300	NAD	C5N-C4N-C3N	-7.20	111.83	120.34
2	C	300	NAD	N3A-C2A-N1A	-4.34	121.90	128.68
2	A	300	NAD	N3A-C2A-N1A	-4.31	121.94	128.68
2	D	300	NAD	N3A-C2A-N1A	-4.28	122.00	128.68
2	C	300	NAD	C2A-N1A-C6A	4.04	125.67	118.75
2	D	300	NAD	C2A-N1A-C6A	4.04	125.66	118.75
2	A	300	NAD	C2A-N1A-C6A	3.97	125.54	118.75
2	C	300	NAD	C6N-N1N-C2N	-3.49	118.79	121.97
2	A	300	NAD	O4D-C1D-C2D	-3.12	102.37	106.93
2	D	300	NAD	C6N-N1N-C2N	-3.11	119.14	121.97
2	A	300	NAD	C6N-N1N-C2N	-2.83	119.39	121.97
2	D	300	NAD	O4D-C1D-C2D	-2.60	103.13	106.93
2	C	300	NAD	C5A-C6A-N1A	-2.55	114.56	120.35
2	D	300	NAD	C5A-C6A-N1A	-2.52	114.65	120.35

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	300	NAD	C5A-C6A-N1A	-2.48	114.73	120.35
2	C	300	NAD	O4D-C1D-C2D	-2.46	103.33	106.93
2	C	300	NAD	C2N-C3N-C4N	2.41	120.99	118.26
2	A	300	NAD	C2N-C3N-C4N	2.41	120.98	118.26
2	D	300	NAD	C2N-C3N-C4N	2.40	120.98	118.26
2	A	300	NAD	O2B-C2B-C3B	2.28	119.21	111.82
2	A	300	NAD	C3N-C7N-N7N	2.25	120.45	117.75
2	C	300	NAD	N6A-C6A-N1A	2.15	123.03	118.57
2	C	300	NAD	O2B-C2B-C3B	2.05	118.47	111.82
2	A	300	NAD	N6A-C6A-N1A	2.03	122.79	118.57
2	D	300	NAD	C3N-C7N-N7N	2.03	120.19	117.75

There are no chirality outliers.

All (30) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	300	NAD	C5D-O5D-PN-O1N
2	A	300	NAD	C5D-O5D-PN-O2N
2	A	300	NAD	O4D-C1D-N1N-C2N
2	A	300	NAD	O4D-C1D-N1N-C6N
2	A	300	NAD	C2D-C1D-N1N-C6N
2	C	300	NAD	C5D-O5D-PN-O1N
2	C	300	NAD	C5D-O5D-PN-O2N
2	C	300	NAD	O4D-C1D-N1N-C6N
2	C	300	NAD	C2D-C1D-N1N-C6N
2	D	300	NAD	C5D-O5D-PN-O1N
2	D	300	NAD	C5D-O5D-PN-O2N
3	A	301	3HL	C-CA-CB-OG1
3	A	301	3HL	C-CA-CB-CG2
2	A	300	NAD	PN-O3-PA-O5B
2	A	300	NAD	C5D-O5D-PN-O3
2	C	300	NAD	C5D-O5D-PN-O3
2	A	300	NAD	PA-O3-PN-O1N
2	C	300	NAD	PA-O3-PN-O2N
2	A	300	NAD	C4N-C3N-C7N-N7N
2	A	300	NAD	C4N-C3N-C7N-O7N
2	A	300	NAD	PA-O3-PN-O2N
2	D	300	NAD	PA-O3-PN-O2N
2	C	300	NAD	O4B-C4B-C5B-O5B
2	C	300	NAD	PN-O3-PA-O5B
2	D	300	NAD	O4B-C4B-C5B-O5B
2	A	300	NAD	C2N-C3N-C7N-N7N

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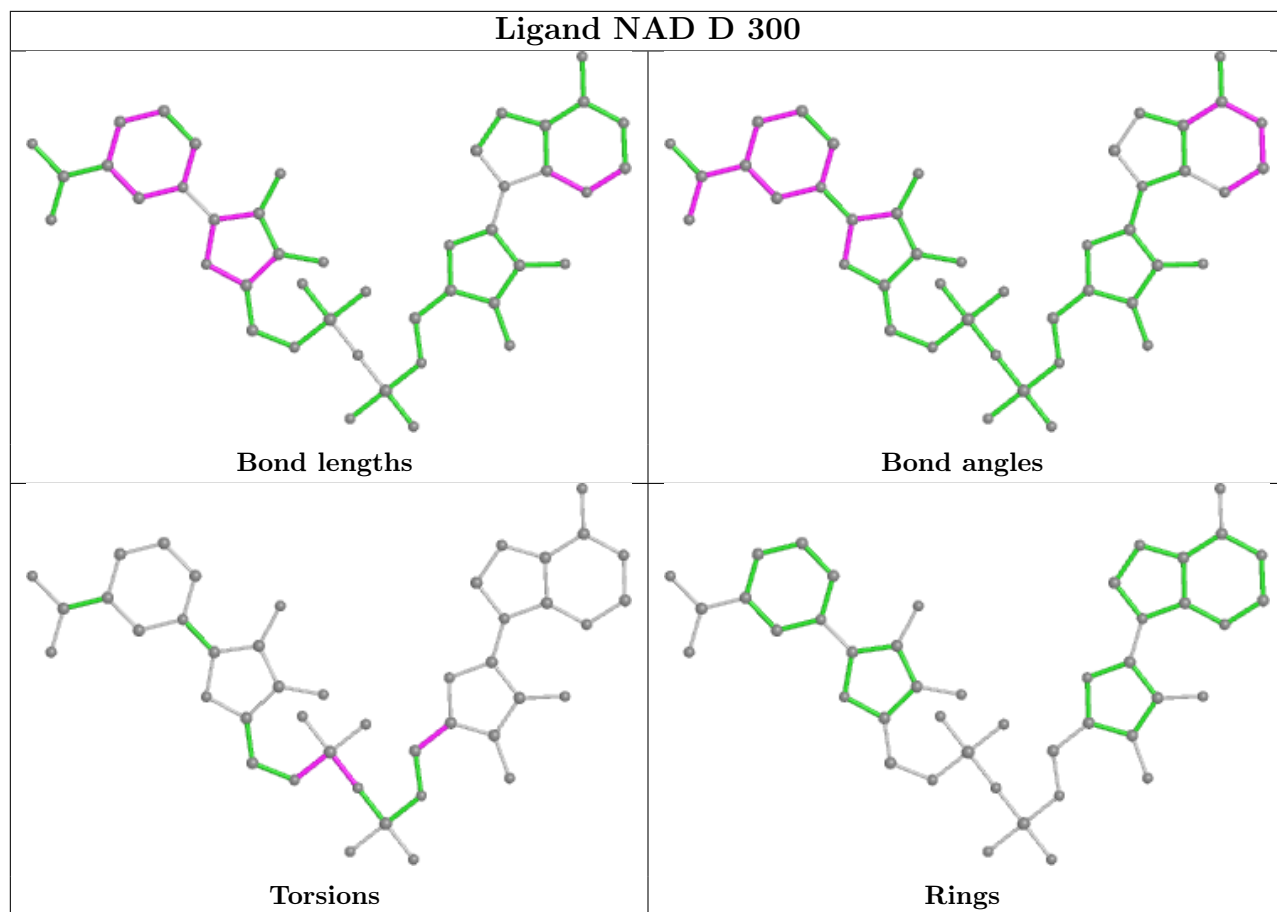
Mol	Chain	Res	Type	Atoms
2	A	300	NAD	O4B-C4B-C5B-O5B
2	D	300	NAD	C5D-O5D-PN-O3
2	C	300	NAD	PA-O3-PN-O1N
2	D	300	NAD	PA-O3-PN-O1N

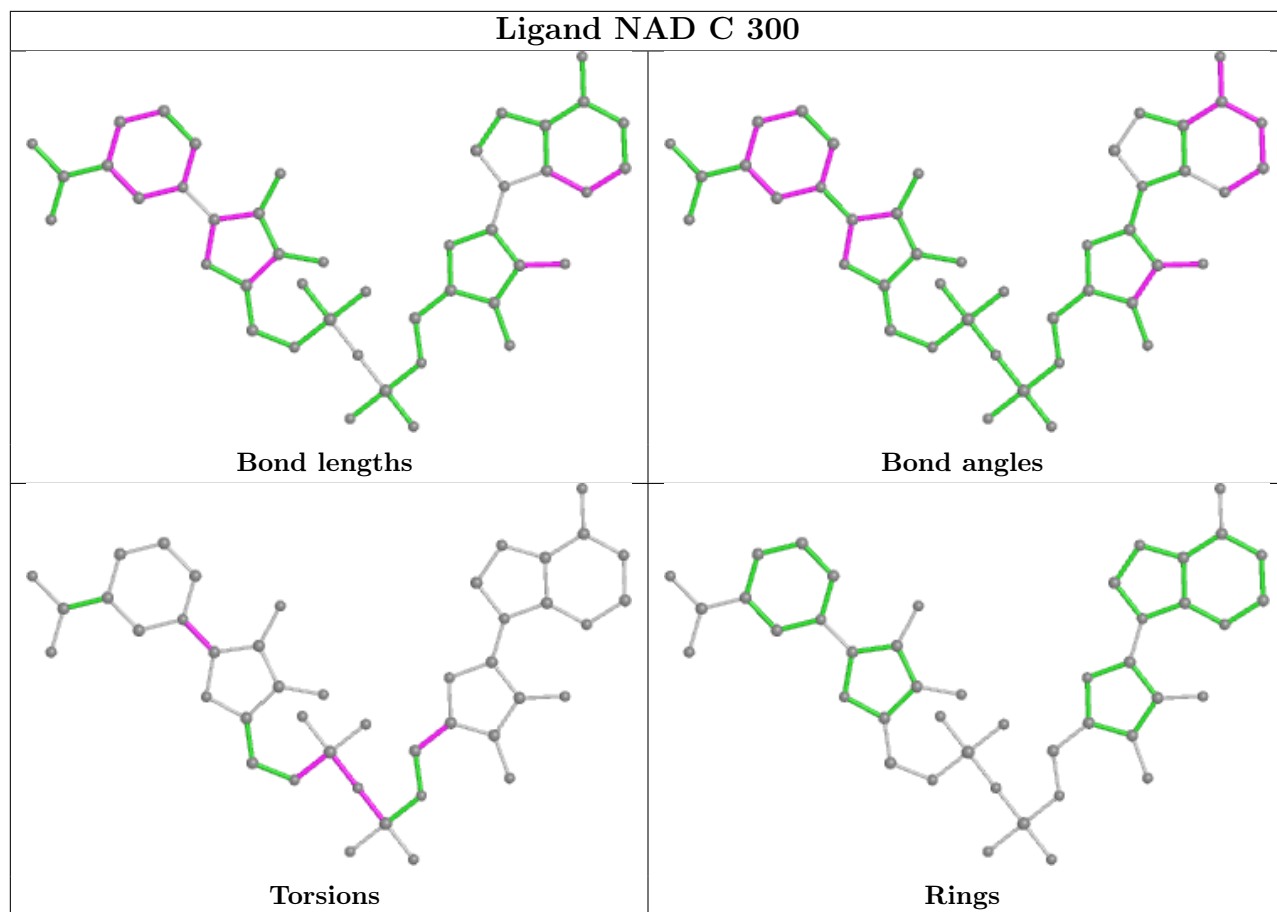
There are no ring outliers.

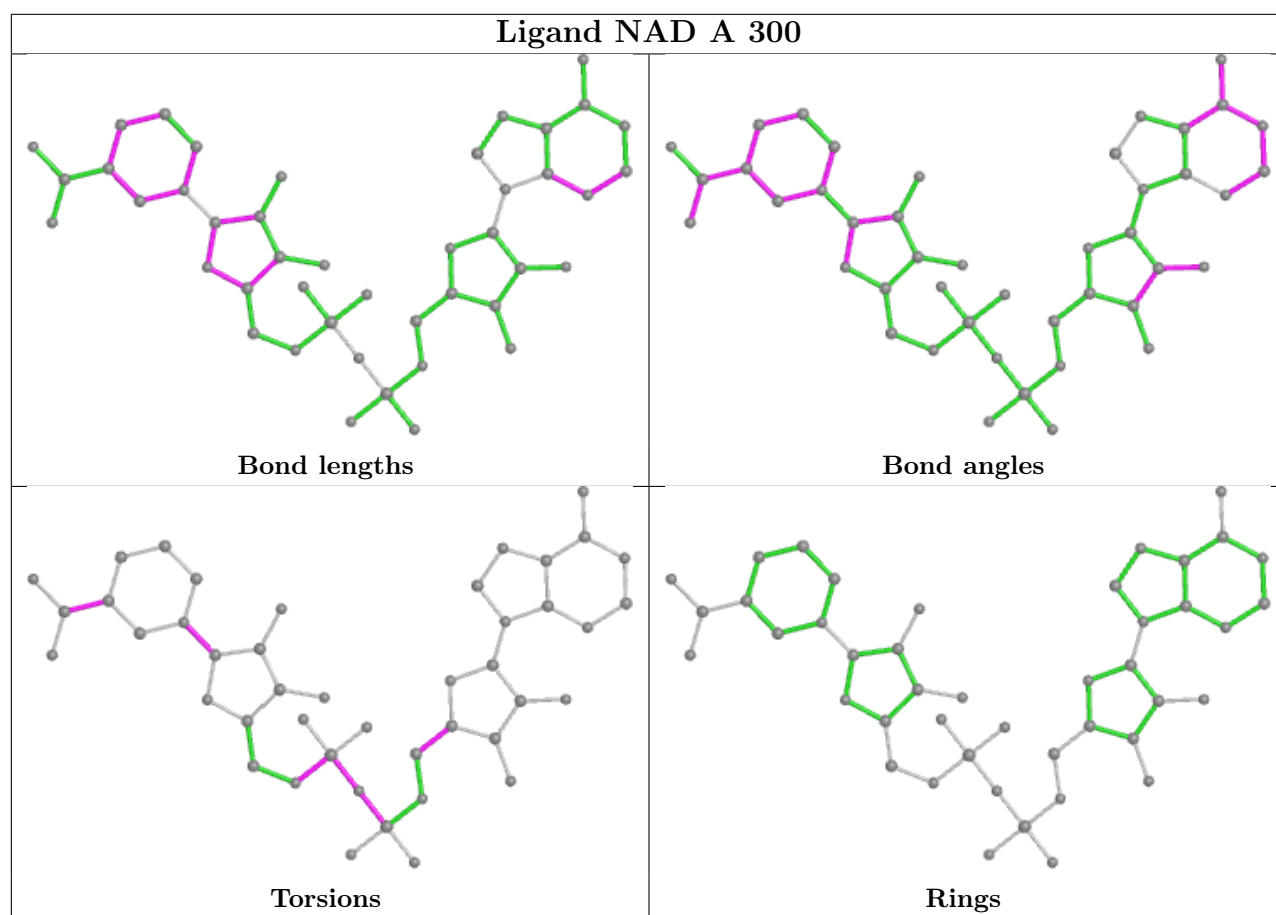
3 monomers are involved in 11 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	300	NAD	5	0
2	C	300	NAD	3	0
2	A	300	NAD	3	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 than 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.







## 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	255/260 (98%)	0.55	23 (9%) <b>9</b> <b>12</b>	20, 40, 64, 78	0
1	B	224/260 (86%)	1.43	66 (29%) <b>0</b> <b>0</b>	32, 56, 79, 83	0
1	C	250/260 (96%)	0.19	14 (5%) <b>24</b> <b>30</b>	19, 28, 64, 79	0
1	D	247/260 (95%)	0.30	16 (6%) <b>18</b> <b>24</b>	21, 34, 65, 85	1 (0%)
All	All	976/1040 (93%)	0.60	119 (12%) <b>4</b> <b>6</b>	19, 39, 74, 85	1 (0%)

All (119) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	201	ALA	7.6
1	C	199	ALA	7.5
1	C	193	VAL	6.9
1	D	198	SER	6.4
1	C	200	LEU	6.3
1	D	193	VAL	6.2
1	B	31	ILE	5.8
1	D	199	ALA	5.6
1	C	191	PRO	5.5
1	B	58	LEU	5.5
1	C	197	ILE	5.2
1	B	51	ALA	5.1
1	D	197	ILE	5.1
1	B	55	VAL	5.0
1	A	201	ALA	4.9
1	A	204	ASN	4.9
1	B	33	LEU	4.9
1	B	189	ARG	4.8
1	C	198	SER	4.7
1	B	13	THR	4.5
1	B	62	ALA	4.4

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	D	196	GLN	4.4
1	B	212	ALA	4.3
1	D	146	LEU	4.3
1	B	63	ASP	4.3
1	B	91	ALA	4.2
1	B	214	GLU	4.1
1	B	32	VAL	4.1
1	B	7	ALA	3.9
1	B	216	LEU	3.9
1	B	67	GLY	3.8
1	C	146	LEU	3.8
1	B	49	LEU	3.7
1	B	64	LEU	3.7
1	C	195	LYS	3.7
1	A	163	VAL	3.7
1	B	15	GLY	3.6
1	B	52	GLN	3.6
1	B	56	LYS	3.6
1	B	57	VAL	3.5
1	A	184	CYS	3.5
1	A	146	LEU	3.4
1	B	53	HIS	3.4
1	D	192	LEU	3.4
1	B	18	LEU	3.4
1	A	131	LYS	3.3
1	D	191	PRO	3.2
1	B	188	VAL	3.2
1	B	128	HIS	3.2
1	D	249	THR	3.2
1	A	251	VAL	3.1
1	B	59	TYR	3.1
1	B	25	ALA	3.1
1	B	6	VAL	3.0
1	A	51	ALA	3.0
1	B	76	ASN	3.0
1	D	97	ALA	3.0
1	A	54	GLY	3.0
1	B	36	PHE	3.0
1	B	225	PHE	3.0
1	B	22	THR	3.0
1	D	190	SER	2.9
1	B	21	ALA	2.9

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	A	183	ILE	2.9
1	A	250	THR	2.9
1	B	213	ARG	2.9
1	C	202	GLU	2.9
1	A	249	THR	2.8
1	A	182	ALA	2.8
1	B	215	LEU	2.8
1	B	250	THR	2.8
1	B	50	ALA	2.8
1	B	229	GLU	2.8
1	B	80	GLN	2.7
1	B	8	VAL	2.7
1	B	78	VAL	2.7
1	B	105	GLU	2.7
1	A	205	GLY	2.7
1	B	182	ALA	2.6
1	B	12	SER	2.6
1	B	84	ILE	2.6
1	B	81	MET	2.6
1	B	54	GLY	2.6
1	B	70	VAL	2.6
1	B	72	GLY	2.6
1	B	249	THR	2.5
1	A	253	VAL	2.5
1	A	210	THR	2.5
1	B	190	SER	2.5
1	B	29	ALA	2.5
1	B	77	ALA	2.4
1	D	251	VAL	2.4
1	C	147	VAL	2.4
1	C	192	LEU	2.4
1	B	79	ARG	2.4
1	B	248	GLY	2.4
1	C	203	LYS	2.3
1	A	206	VAL	2.3
1	B	74	VAL	2.3
1	B	24	LEU	2.3
1	D	189	ARG	2.3
1	B	61	GLY	2.3
1	B	48	GLY	2.2
1	B	252	SER	2.2
1	C	251	VAL	2.2

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Mol	Chain	Res	Type	RSRZ
1	D	195	LYS	2.2
1	B	109	ALA	2.2
1	A	203	LYS	2.2
1	B	246	ILE	2.1
1	D	147	VAL	2.1
1	A	185	PRO	2.1
1	A	258	THR	2.1
1	A	224	GLN	2.1
1	B	26	ALA	2.1
1	A	145	GLY	2.1
1	B	251	VAL	2.1
1	A	252	SER	2.0
1	B	87	LEU	2.0
1	D	143	ALA	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.

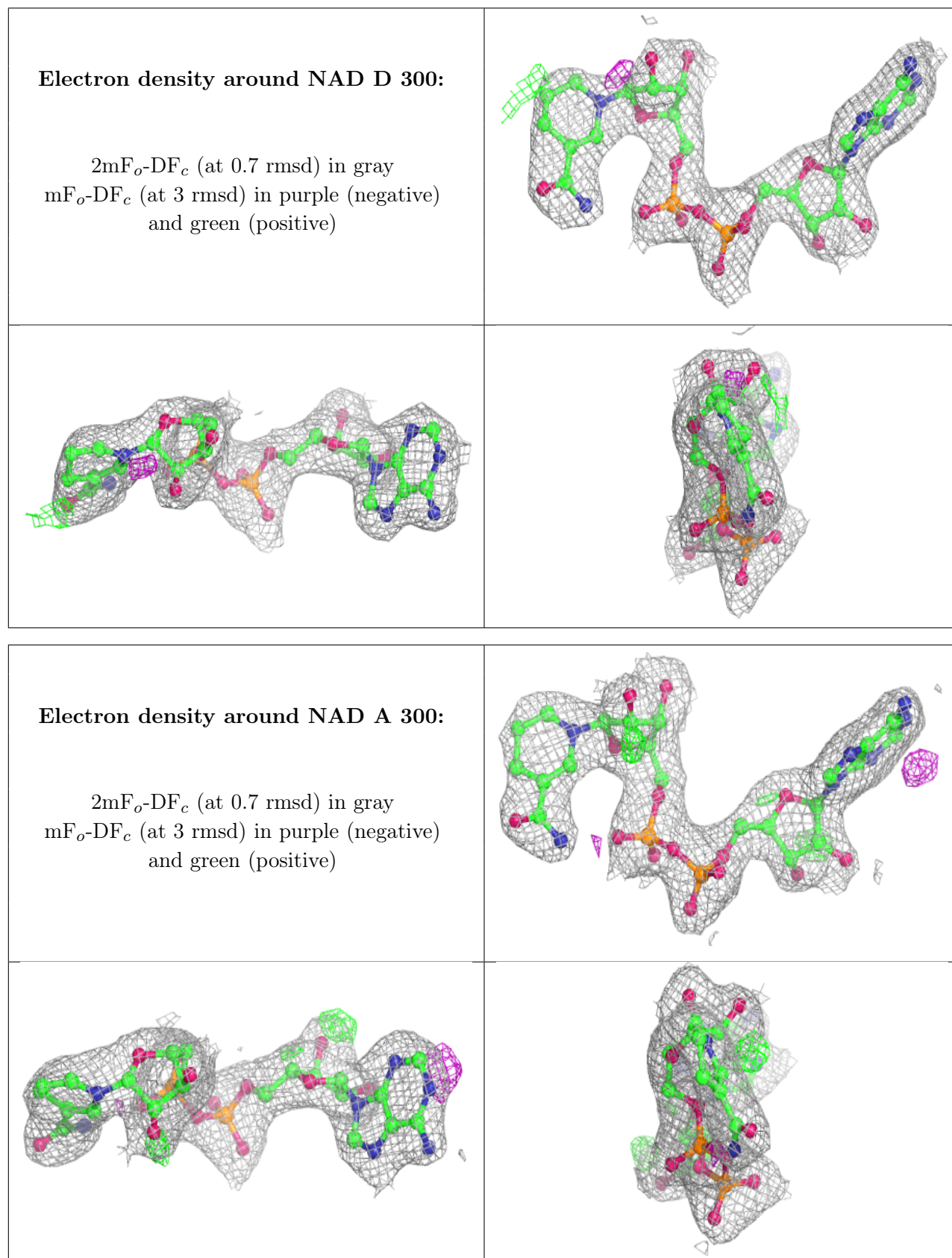
## 6.4 Ligands [i](#)

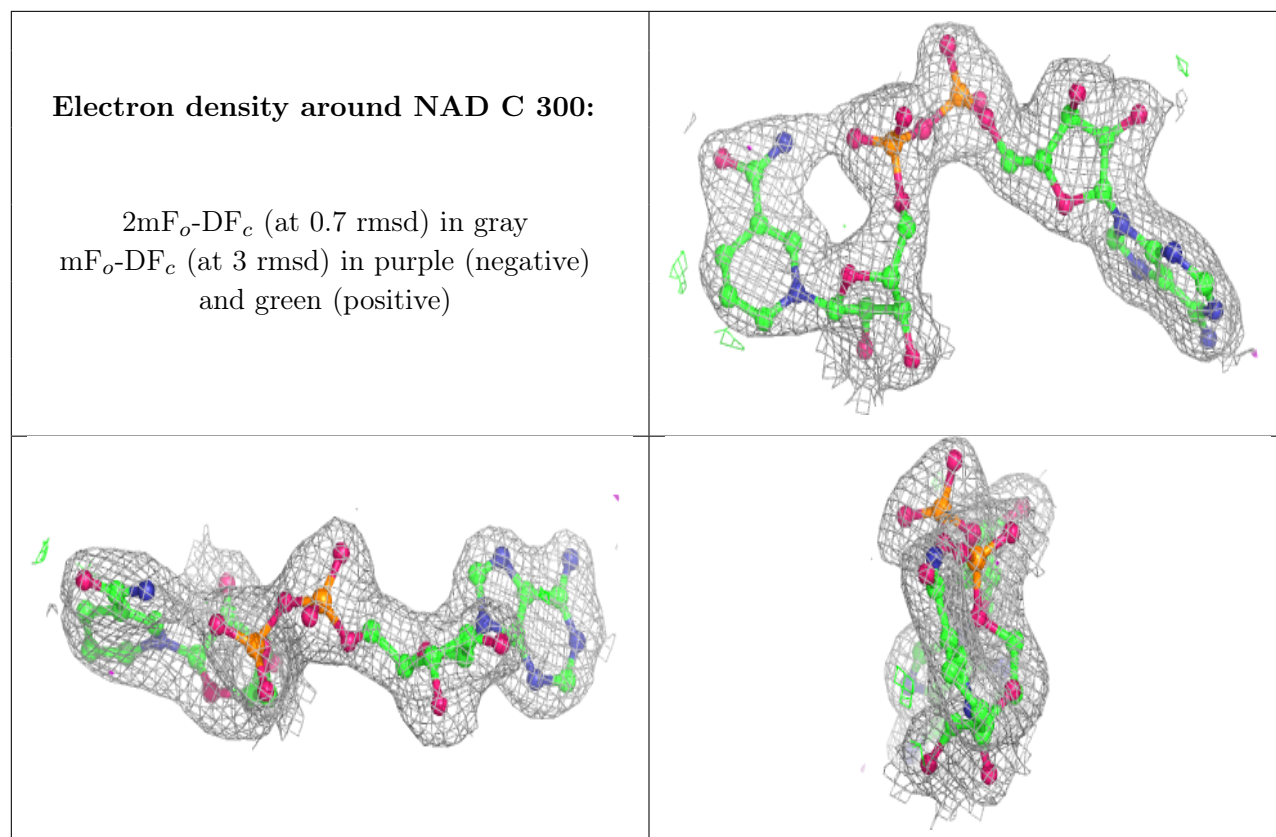
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å <sup>2</sup> )	Q<0.9
4	MG	A	406	1/1	0.79	0.38	42,42,42,42	0
2	NAD	D	300	44/44	0.93	0.12	39,46,51,52	0
2	NAD	A	300	44/44	0.93	0.15	34,40,43,44	0
4	MG	B	401	1/1	0.93	0.28	42,42,42,42	0
2	NAD	C	300	44/44	0.96	0.12	31,38,44,47	0
3	3HL	A	301	7/7	0.96	0.17	45,47,48,48	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers

as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.





## 6.5 Other polymers [i](#)

There are no such residues in this entry.