



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 24, 2024 – 09:14 pm GMT

PDB ID : 5LC1  
Title : L-threonine dehydrogenase from Trypanosoma brucei with NAD and the inhibitor pyruvate bound.  
Authors : Erskine, P.T.; Adjogatse, E.; Wood, S.P.; Cooper, J.B.  
Deposited on : 2016-06-18  
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 : 1.8.4, 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

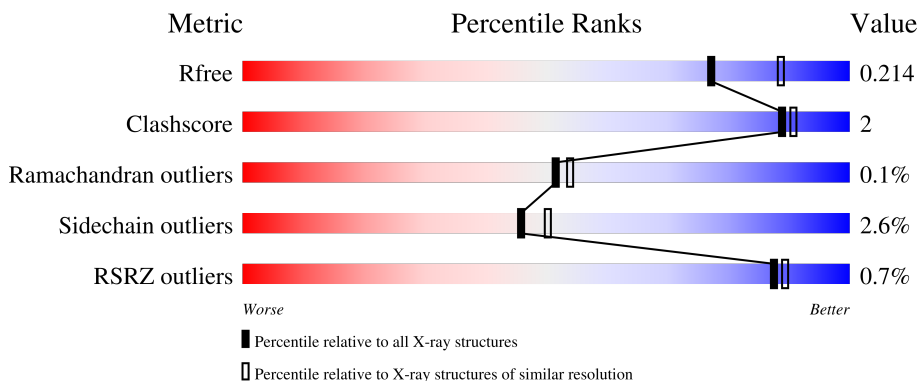
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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	321	95% .
1	B	321	92% 7% .
1	C	321	93% 7% .
1	D	321	92% 7% .
1	E	321	90% 9% .

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Mol	Chain	Length	Quality of chain
1	F	321	 <p>A horizontal bar chart representing the quality of the chain. The bar is primarily green, indicating a high quality score of 90%. A small yellow segment at the end indicates a lower quality score of 9%. The bar is labeled with a '%' symbol at the start and '90%' and '9%' at the corresponding positions along the bar.</p>

## 2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 17331 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 L-threonine 3-dehydrogenase.

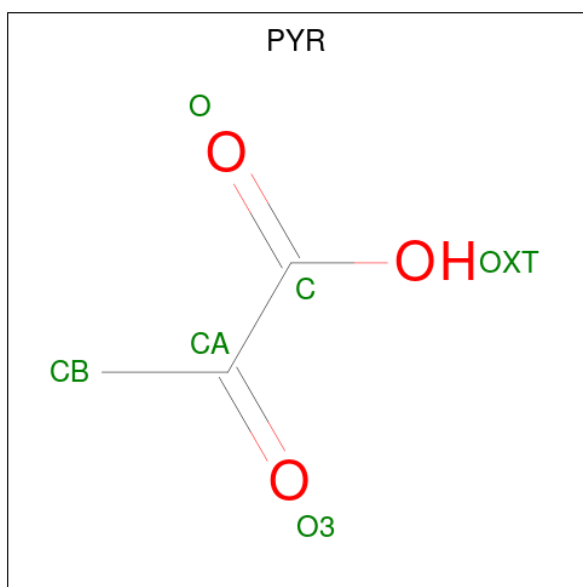
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	320	2500	1595	416	470	19	0	0	0
1	B	321	2520	1606	421	474	19	0	1	0
1	C	320	2501	1595	416	471	19	0	0	0
1	D	320	2510	1600	417	474	19	0	1	0
1	E	320	2510	1601	418	472	19	0	1	0
1	F	319	2502	1597	418	468	19	0	1	0

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	HIS	-	expression tag	UNP Q7YW97
A	2	MET	-	expression tag	UNP Q7YW97
B	1	HIS	-	expression tag	UNP Q7YW97
B	2	MET	-	expression tag	UNP Q7YW97
C	1	HIS	-	expression tag	UNP Q7YW97
C	2	MET	-	expression tag	UNP Q7YW97
D	1	HIS	-	expression tag	UNP Q7YW97
D	2	MET	-	expression tag	UNP Q7YW97
E	1	HIS	-	expression tag	UNP Q7YW97
E	2	MET	-	expression tag	UNP Q7YW97
F	1	HIS	-	expression tag	UNP Q7YW97
F	2	MET	-	expression tag	UNP Q7YW97

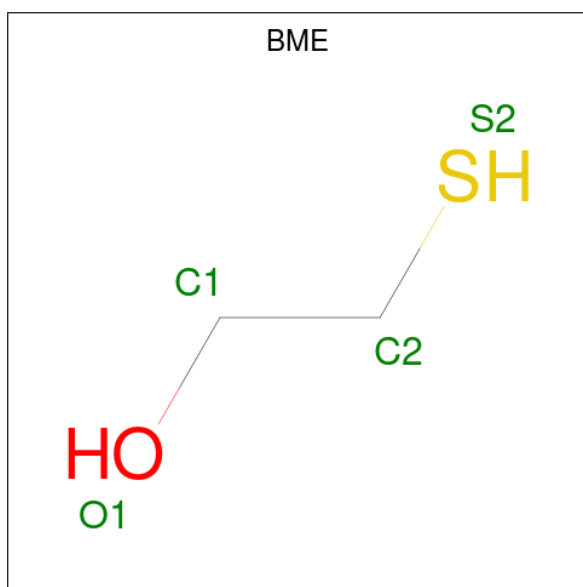
- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula: C<sub>21</sub>H<sub>27</sub>N<sub>7</sub>O<sub>14</sub>P<sub>2</sub>).





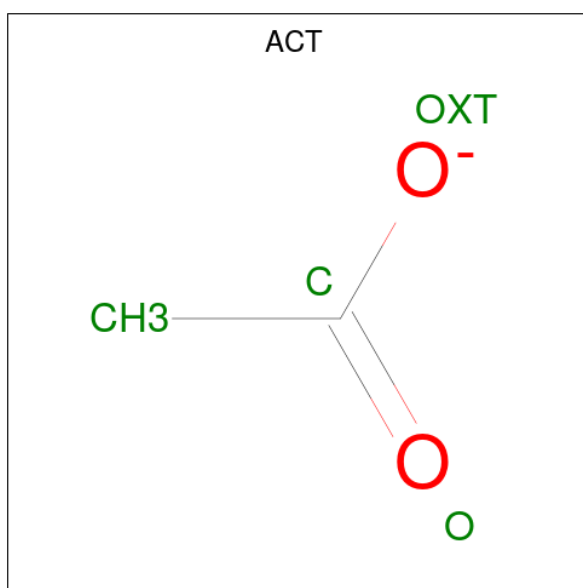
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			6	3	3		
3	B	1	Total	C	O	0	0
			6	3	3		
3	C	1	Total	C	O	0	0
			6	3	3		
3	D	1	Total	C	O	0	0
			6	3	3		
3	E	1	Total	C	O	0	0
			6	3	3		
3	F	1	Total	C	O	0	0
			6	3	3		

- Molecule 4 is BETA-MERCAPTOETHANOL (three-letter code: BME) (formula: C<sub>2</sub>H<sub>6</sub>OS).



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

- Molecule 5 is ACETATE ION (three-letter code: ACT) (formula:  $C_2H_3O_2^-$ ).



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

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	E	1	Total	C	O	0	0
			4	2	2		

- Molecule 6 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	Na	0	0
			1	1		
6	B	1	Total	Na	0	0
			1	1		
6	C	1	Total	Na	0	0
			1	1		
6	D	1	Total	Na	0	0
			1	1		
6	E	1	Total	Na	0	0
			1	1		
6	F	1	Total	Na	0	0
			1	1		

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	342	Total	O	0	0
			342	342		
7	B	358	Total	O	0	0
			358	358		
7	C	305	Total	O	0	0
			305	305		
7	D	335	Total	O	0	0
			335	335		
7	E	277	Total	O	0	0
			277	277		
7	F	345	Total	O	0	0
			345	345		



### 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: L-threonine 3-dehydrogenase

Chain A:  95%



- Molecule 1: L-threonine 3-dehydrogenase

Chain B:  92% 7%



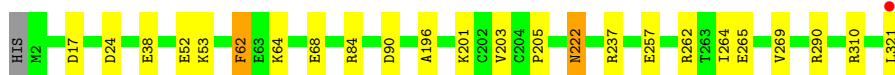
- Molecule 1: L-threonine 3-dehydrogenase

Chain C:  93% 7%



- Molecule 1: L-threonine 3-dehydrogenase

Chain D:  92% 7%



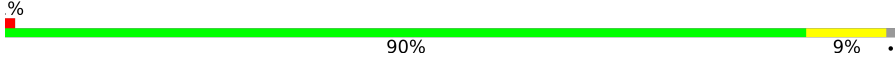
- Molecule 1: L-threonine 3-dehydrogenase

Chain E:  90% 9% 2%



L321

## ● Molecule 1: L-threonine 3-dehydrogenase

Chain F:  %

Residues: H1, M2, T8, D17, D29, L32, L45, L48, K49, E52, K53, F62, L65, E68, H76, M111, I112, R113, I114, F115, K129, K133, R167, T179, L180, K201, L212, L221, K234, R237, S246, R290, D300, P319, SER

LEU

## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	132.04Å 276.49Å 55.74Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	95.50 – 2.10 69.12 – 2.10	Depositor EDS
% Data completeness (in resolution range)	97.3 (95.50-2.10) 97.3 (69.12-2.10)	Depositor EDS
$R_{merge}$	0.14	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.66 (at 2.10Å)	Xtrriage
Refinement program	REFMAC 5.8.0151	Depositor
R, $R_{free}$	0.147 , 0.208 0.157 , 0.214	Depositor DCC
$R_{free}$ test set	5563 reflections (4.75%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	19.3	Xtrriage
Anisotropy	0.088	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 52.1	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	0.96	EDS
Total number of atoms	17331	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	23.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 31.82 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 1.0398e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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: ACT, BME, NA, PYR, 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	0.83	0/2556	0.95	9/3469 (0.3%)
1	B	0.83	2/2577 (0.1%)	0.87	3/3496 (0.1%)
1	C	0.85	0/2557	0.96	8/3469 (0.2%)
1	D	0.83	0/2566	0.92	8/3481 (0.2%)
1	E	0.81	0/2566	0.92	8/3480 (0.2%)
1	F	0.83	0/2562	0.92	6/3476 (0.2%)
All	All	0.83	2/15384 (0.0%)	0.92	42/20871 (0.2%)

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 (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	188	TYR	CE1-CZ	6.71	1.47	1.38
1	B	152	GLU	CD-OE2	5.28	1.31	1.25

All (42) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	237	ARG	NE-CZ-NH2	-11.33	114.64	120.30
1	C	237	ARG	NE-CZ-NH1	10.49	125.54	120.30
1	A	237	ARG	NE-CZ-NH2	-9.71	115.44	120.30
1	F	237	ARG	NE-CZ-NH2	-9.49	115.56	120.30
1	D	290	ARG	NE-CZ-NH1	9.14	124.87	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	F	237	ARG	NE-CZ-NH1	8.63	124.62	120.30
1	A	253	ARG	NE-CZ-NH1	8.54	124.57	120.30
1	A	253	ARG	NE-CZ-NH2	-8.31	116.14	120.30
1	D	237	ARG	NE-CZ-NH2	-8.14	116.23	120.30
1	E	214	MET	CG-SD-CE	8.03	113.04	100.20
1	A	237	ARG	NE-CZ-NH1	7.83	124.21	120.30
1	D	290	ARG	NE-CZ-NH2	-7.18	116.71	120.30
1	A	264	ILE	CB-CA-C	-7.07	97.45	111.60
1	B	237	ARG	NE-CZ-NH2	-6.81	116.89	120.30
1	E	23	ARG	NE-CZ-NH2	-6.78	116.91	120.30
1	C	23	ARG	NE-CZ-NH1	6.67	123.63	120.30
1	D	237	ARG	NE-CZ-NH1	6.62	123.61	120.30
1	A	307	ASP	CB-CG-OD1	-6.53	112.42	118.30
1	C	285	ASP	CB-CG-OD1	6.47	124.13	118.30
1	A	84	ARG	NE-CZ-NH2	-6.40	117.10	120.30
1	E	125	ASP	CB-CG-OD1	6.36	124.02	118.30
1	E	23	ARG	NE-CZ-NH1	6.22	123.41	120.30
1	F	113	ARG	NE-CZ-NH1	-6.03	117.28	120.30
1	C	84	ARG	NE-CZ-NH2	-6.02	117.29	120.30
1	D	84	ARG	NE-CZ-NH2	-6.00	117.30	120.30
1	C	74	MET	CG-SD-CE	5.95	109.71	100.20
1	E	300	ASP	CB-CG-OD1	5.93	123.64	118.30
1	F	300	ASP	CB-CG-OD1	5.91	123.61	118.30
1	B	23	ARG	NE-CZ-NH1	5.90	123.25	120.30
1	D	84	ARG	NE-CZ-NH1	5.83	123.22	120.30
1	E	237	ARG	NE-CZ-NH2	-5.73	117.43	120.30
1	B	159	ARG	NE-CZ-NH2	-5.71	117.45	120.30
1	F	180	LEU	N-CA-CB	5.51	121.42	110.40
1	E	300	ASP	CB-CG-OD2	-5.38	113.45	118.30
1	C	300	ASP	CB-CG-OD1	5.30	123.07	118.30
1	F	290	ARG	NE-CZ-NH1	5.23	122.92	120.30
1	E	170	ARG	NE-CZ-NH2	-5.22	117.69	120.30
1	C	285	ASP	CB-CG-OD2	-5.15	113.66	118.30
1	A	282	ASP	CB-CG-OD1	5.09	122.88	118.30
1	A	84	ARG	NE-CZ-NH1	5.05	122.83	120.30
1	D	62	PHE	CB-CG-CD2	-5.01	117.29	120.80
1	D	17	ASP	CB-CG-OD1	5.00	122.80	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	320	SER	Peptide

## 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	2500	0	2511	2	0
1	B	2520	0	2528	9	0
1	C	2501	0	2512	7	0
1	D	2510	0	2517	9	0
1	E	2510	0	2524	18	0
1	F	2502	0	2519	13	0
2	A	44	0	26	0	0
2	B	44	0	26	0	0
2	C	44	0	26	0	0
2	D	44	0	26	0	0
2	E	44	0	26	0	0
2	F	44	0	26	0	0
3	A	6	0	0	0	0
3	B	6	0	0	0	0
3	C	6	0	0	0	0
3	D	6	0	0	0	0
3	E	6	0	0	0	0
3	F	6	0	0	0	0
4	A	4	0	5	0	0
4	B	4	0	5	0	0
5	A	4	0	3	0	0
5	B	4	0	3	0	0
5	E	4	0	3	0	0
6	A	1	0	0	0	0
6	B	1	0	0	0	0
6	C	1	0	0	0	0
6	D	1	0	0	0	0
6	E	1	0	0	0	0
6	F	1	0	0	0	0
7	A	342	0	0	1	0
7	B	358	0	0	2	0
7	C	305	0	0	0	0
7	D	335	0	0	2	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
7	E	277	0	0	3	1
7	F	345	0	0	4	1
All	All	17331	0	15286	58	1

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 2.

All (58) 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:E:196:ALA:HB2	1:E:264:ILE:HD11	1.65	0.76
1:F:179:THR:O	1:F:180:LEU:HB2	1.88	0.74
1:C:32:LEU:HD21	1:C:65:LEU:HD11	1.75	0.68
1:B:258:ARG:NH1	1:B:302:ASP:OD1	2.26	0.67
1:C:201:LYS:HE2	1:C:265:GLU:HG2	1.80	0.64
1:E:214:MET:HG3	1:E:247:PHE:CE2	2.35	0.61
1:E:62:PHE:HE1	1:E:74:MET:HE3	1.67	0.58
1:E:264:ILE:HG22	1:E:266:VAL:HG23	1.84	0.58
1:D:205:PRO:HA	1:D:269:VAL:O	2.05	0.56
1:D:196:ALA:HB2	1:D:264:ILE:HD12	1.88	0.55
1:E:175:ILE:HD11	1:E:214:MET:CE	2.36	0.55
1:C:201:LYS:HE2	1:C:265:GLU:CG	2.37	0.55
1:E:271:GLY:O	7:E:601:HOH:O	2.18	0.54
1:F:45:LEU:HD23	1:F:48:LEU:HD12	1.91	0.53
1:D:38:GLU:HG3	1:D:53:LYS:HD2	1.91	0.52
1:F:129:LYS:NZ	7:F:602:HOH:O	2.42	0.51
1:E:175:ILE:HD11	1:E:214:MET:HE3	1.93	0.51
1:E:62:PHE:CE1	1:E:74:MET:HE3	2.46	0.50
1:F:179:THR:O	7:F:601:HOH:O	2.20	0.49
1:B:7:VAL:HB	1:B:33:VAL:HG22	1.93	0.49
1:E:160:GLN:OE1	7:E:602:HOH:O	2.20	0.48
1:B:290:ARG:NH2	7:B:602:HOH:O	2.46	0.48
1:A:101:ARG:HG3	7:A:604:HOH:O	2.14	0.48
1:F:32:LEU:HD21	1:F:65:LEU:HD11	1.95	0.48
1:F:290:ARG:HD2	7:F:846:HOH:O	2.13	0.48
1:B:255:SER:HA	1:B:258:ARG:NH1	2.29	0.47
1:D:90:ASP:OD2	7:D:601:HOH:O	2.20	0.47
1:E:256:ILE:HG21	1:E:264:ILE:HD11	1.97	0.47
1:B:198:LEU:HG	1:B:318:LEU:HD13	1.96	0.47
1:F:8:THR:OG1	1:F:76:HIS:HA	2.15	0.47
1:D:203:VAL:O	1:D:203:VAL:HG23	2.15	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:201:LYS:HG3	1:D:265:GLU:HG3	1.97	0.46
1:F:115:PHE:HA	1:F:167:ARG:O	2.16	0.46
1:D:64:LYS:O	1:D:68[B]:GLU:HG2	2.15	0.45
1:C:32:LEU:HD11	1:C:52:GLU:CG	2.47	0.45
1:C:8:THR:OG1	1:C:76:HIS:HA	2.17	0.44
1:C:17:ASP:HB3	1:C:221:LEU:HD11	1.99	0.44
1:B:8:THR:OG1	1:B:76:HIS:HA	2.18	0.43
1:E:290:ARG:HD2	7:E:814:HOH:O	2.17	0.43
1:B:132:THR:OG1	1:B:281:PRO:HB3	2.18	0.43
1:D:222:ASN:ND2	7:D:607:HOH:O	2.52	0.43
1:F:68:GLU:HG3	7:F:882:HOH:O	2.19	0.43
1:E:175:ILE:HD11	1:E:214:MET:HE2	2.01	0.42
1:F:32:LEU:HD11	1:F:52:GLU:CG	2.50	0.42
1:E:214:MET:HG3	1:E:247:PHE:CZ	2.55	0.42
1:E:264:ILE:CG2	1:E:266:VAL:HG23	2.48	0.42
1:F:32:LEU:HD11	1:F:52:GLU:HG2	2.01	0.42
1:A:214:MET:HG3	1:A:247:PHE:CE2	2.55	0.42
1:F:17:ASP:HB3	1:F:221:LEU:HD11	2.03	0.41
1:C:109:LYS:HB3	1:C:110:TYR:CD2	2.55	0.41
1:B:290:ARG:HD2	7:B:893:HOH:O	2.20	0.41
1:D:257:GLU:CG	1:D:264:ILE:HG22	2.51	0.41
1:E:318:LEU:HG	1:E:319:PRO:HD2	2.03	0.41
1:E:310:ARG:O	1:E:313:PRO:HD2	2.21	0.40
1:B:205:PRO:HA	1:B:269:VAL:O	2.21	0.40
1:F:212:LEU:O	1:F:246:SER:HA	2.21	0.40
1:E:159:ARG:HD2	1:E:164:VAL:O	2.22	0.40
1:E:201:LYS:HD2	1:E:267:GLU:OE2	2.22	0.40

All (1) 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)
7:E:602:HOH:O	7:F:780:HOH:O[2_656]	1.95	0.25

## 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	318/321 (99%)	312 (98%)	6 (2%)	0	100	100
1	B	320/321 (100%)	314 (98%)	6 (2%)	0	100	100
1	C	318/321 (99%)	312 (98%)	6 (2%)	0	100	100
1	D	319/321 (99%)	312 (98%)	7 (2%)	0	100	100
1	E	319/321 (99%)	311 (98%)	7 (2%)	1 (0%)	41	41
1	F	318/321 (99%)	311 (98%)	6 (2%)	1 (0%)	41	41
All	All	1912/1926 (99%)	1872 (98%)	38 (2%)	2 (0%)	51	54

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	320	SER
1	F	180	LEU

### 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	277/278 (100%)	273 (99%)	4 (1%)	67	73
1	B	279/278 (100%)	270 (97%)	9 (3%)	39	41
1	C	277/278 (100%)	270 (98%)	7 (2%)	47	52
1	D	278/278 (100%)	271 (98%)	7 (2%)	47	52
1	E	278/278 (100%)	271 (98%)	7 (2%)	47	52
1	F	277/278 (100%)	268 (97%)	9 (3%)	39	41
All	All	1666/1668 (100%)	1623 (97%)	43 (3%)	46	50

All (43) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	MET
1	A	29	ASP
1	A	62	PHE
1	A	275	LYS
1	B	24	ASP
1	B	29	ASP
1	B	33	VAL
1	B	52	GLU
1	B	53	LYS
1	B	62	PHE
1	B	264	ILE
1	B	298	LYS
1	B	318	LEU
1	C	52	GLU
1	C	53	LYS
1	C	60	ASN
1	C	62	PHE
1	C	261	ASP
1	C	298	LYS
1	C	320	SER
1	D	24	ASP
1	D	52	GLU
1	D	62	PHE
1	D	222	ASN
1	D	262	ARG
1	D	310	ARG
1	D	321	LEU
1	E	25	LYS
1	E	29	ASP
1	E	33	VAL
1	E	62	PHE
1	E	67	LYS
1	E	159	ARG
1	E	265	GLU
1	F	2	MET
1	F	29	ASP
1	F	49	LYS
1	F	53	LYS
1	F	62	PHE
1	F	111	ASN
1	F	133	LYS
1	F	201	LYS
1	F	234	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	60	ASN
1	A	191	HIS
1	A	296	GLN
1	D	291	ASN
1	E	60	ASN
1	E	311	GLN
1	F	60	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 [i](#)

Of 23 ligands modelled in this entry, 6 are monoatomic - leaving 17 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	500	-	42,48,48	1.00	3 (7%)	50,73,73	1.26	7 (14%)
3	PYR	D	501	-	5,5,5	1.64	2 (40%)	3,6,6	1.54	1 (33%)
5	ACT	B	503	-	3,3,3	1.52	1 (33%)	3,3,3	1.36	0
4	BME	A	502	1	3,3,3	0.53	0	1,2,2	0.13	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	NAD	B	500	-	42,48,48	0.94	1 (2%)	50,73,73	1.17	5 (10%)
2	NAD	A	500	-	42,48,48	0.97	2 (4%)	50,73,73	1.30	5 (10%)
3	PYR	B	501	-	5,5,5	1.49	1 (20%)	3,6,6	1.20	0
3	PYR	F	501	-	5,5,5	1.17	0	3,6,6	1.13	0
3	PYR	A	501	-	5,5,5	1.53	1 (20%)	3,6,6	0.99	0
5	ACT	A	503	-	3,3,3	1.70	1 (33%)	3,3,3	1.32	0
4	BME	B	502	1	3,3,3	0.70	0	1,2,2	0.01	0
2	NAD	F	500	-	42,48,48	0.97	3 (7%)	50,73,73	1.08	4 (8%)
3	PYR	E	501	-	5,5,5	1.51	1 (20%)	3,6,6	1.39	0
3	PYR	C	501	-	5,5,5	1.53	1 (20%)	3,6,6	1.41	0
2	NAD	E	500	-	42,48,48	1.08	4 (9%)	50,73,73	1.30	6 (12%)
2	NAD	C	500	-	42,48,48	0.93	2 (4%)	50,73,73	1.23	6 (12%)
5	ACT	E	502	-	3,3,3	0.83	0	3,3,3	1.43	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	NAD	D	500	-	-	1/26/62/62	0/5/5/5
3	PYR	D	501	-	-	2/4/4/4	-
4	BME	A	502	1	-	1/1/1/1	-
2	NAD	B	500	-	-	1/26/62/62	0/5/5/5
2	NAD	A	500	-	-	3/26/62/62	0/5/5/5
3	PYR	B	501	-	-	0/4/4/4	-
3	PYR	F	501	-	-	0/4/4/4	-
3	PYR	A	501	-	-	2/4/4/4	-
4	BME	B	502	1	-	1/1/1/1	-
2	NAD	F	500	-	-	4/26/62/62	0/5/5/5
3	PYR	E	501	-	-	3/4/4/4	-
3	PYR	C	501	-	-	2/4/4/4	-
2	NAD	E	500	-	-	3/26/62/62	0/5/5/5
2	NAD	C	500	-	-	1/26/62/62	0/5/5/5

All (23) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	501	PYR	O-C	2.94	1.30	1.22
5	A	503	ACT	O-C	2.93	1.35	1.22
2	D	500	NAD	C4A-N3A	-2.83	1.31	1.35
3	E	501	PYR	O-C	2.79	1.30	1.22
5	B	503	ACT	O-C	2.61	1.34	1.22
2	C	500	NAD	C2A-N3A	2.54	1.36	1.32
2	C	500	NAD	C2N-N1N	2.46	1.38	1.35
2	E	500	NAD	C2N-C3N	2.42	1.42	1.39
2	F	500	NAD	C2N-N1N	2.32	1.37	1.35
2	A	500	NAD	C2N-N1N	2.31	1.37	1.35
3	B	501	PYR	O-C	2.25	1.28	1.22
3	D	501	PYR	O-C	2.23	1.28	1.22
2	D	500	NAD	C2N-N1N	2.22	1.37	1.35
2	F	500	NAD	C5A-C4A	2.18	1.46	1.40
2	E	500	NAD	C5A-C4A	2.15	1.46	1.40
2	D	500	NAD	C2A-N3A	2.14	1.35	1.32
2	F	500	NAD	C2N-C3N	2.11	1.42	1.39
2	B	500	NAD	C2N-C3N	2.10	1.42	1.39
3	D	501	PYR	O3-CA	2.10	1.27	1.23
3	A	501	PYR	O-C	2.08	1.28	1.22
2	A	500	NAD	O4D-C1D	2.06	1.43	1.41
2	E	500	NAD	C7N-N7N	2.02	1.36	1.33
2	E	500	NAD	C4N-C3N	2.00	1.42	1.39

All (34) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	500	NAD	N3A-C2A-N1A	-3.87	122.62	128.68
2	B	500	NAD	N3A-C2A-N1A	-3.73	122.85	128.68
2	C	500	NAD	N3A-C2A-N1A	-3.67	122.94	128.68
2	A	500	NAD	N3A-C2A-N1A	-3.65	122.97	128.68
2	E	500	NAD	C1B-N9A-C4A	-3.44	120.61	126.64
2	B	500	NAD	PN-O3-PA	-3.12	122.12	132.83
2	E	500	NAD	C3N-C7N-N7N	3.09	121.46	117.75
2	D	500	NAD	N6A-C6A-N1A	2.70	124.19	118.57
2	D	500	NAD	PN-O3-PA	-2.70	123.57	132.83
2	D	500	NAD	C1B-N9A-C4A	-2.68	121.93	126.64
2	E	500	NAD	O2N-PN-O1N	2.68	125.48	112.24
2	D	500	NAD	C3N-C7N-N7N	2.65	120.94	117.75
3	D	501	PYR	O3-CA-CB	2.64	125.59	119.73
2	C	500	NAD	N6A-C6A-N1A	2.60	123.97	118.57
2	B	500	NAD	C1B-N9A-C4A	-2.44	122.36	126.64
2	A	500	NAD	O7N-C7N-C3N	-2.41	116.75	119.63

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	500	NAD	O2N-PN-O1N	2.33	123.75	112.24
2	F	500	NAD	O4B-C4B-C3B	2.30	109.67	105.11
2	F	500	NAD	N6A-C6A-N1A	2.30	123.35	118.57
2	F	500	NAD	C3N-C7N-N7N	2.30	120.51	117.75
2	A	500	NAD	C1B-N9A-C4A	-2.26	122.67	126.64
2	A	500	NAD	O2A-PA-O1A	2.26	123.41	112.24
2	C	500	NAD	O4B-C4B-C3B	2.24	109.55	105.11
2	B	500	NAD	C2A-N1A-C6A	2.19	122.50	118.75
2	A	500	NAD	PN-O3-PA	-2.17	125.38	132.83
2	D	500	NAD	O7N-C7N-C3N	-2.15	117.06	119.63
2	E	500	NAD	PN-O3-PA	-2.13	125.50	132.83
2	F	500	NAD	PN-O3-PA	-2.12	125.56	132.83
2	B	500	NAD	C3N-C7N-N7N	2.08	120.25	117.75
2	D	500	NAD	C4A-C5A-N7A	-2.07	107.24	109.40
2	C	500	NAD	C1B-N9A-C4A	-2.06	123.02	126.64
2	E	500	NAD	C2A-N1A-C6A	2.06	122.27	118.75
2	D	500	NAD	N3A-C2A-N1A	-2.03	125.51	128.68
2	C	500	NAD	C6N-N1N-C2N	-2.03	120.13	121.97

There are no chirality outliers.

All (24) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	500	NAD	C5D-O5D-PN-O1N
2	E	500	NAD	C5D-O5D-PN-O1N
2	F	500	NAD	C5D-O5D-PN-O1N
3	A	501	PYR	OXT-C-CA-CB
3	C	501	PYR	OXT-C-CA-CB
4	A	502	BME	O1-C1-C2-S2
3	C	501	PYR	O-C-CA-CB
3	E	501	PYR	O-C-CA-CB
2	A	500	NAD	C5D-O5D-PN-O3
2	E	500	NAD	C5D-O5D-PN-O3
2	F	500	NAD	C5D-O5D-PN-O3
3	D	501	PYR	OXT-C-CA-CB
3	E	501	PYR	OXT-C-CA-CB
4	B	502	BME	O1-C1-C2-S2
3	E	501	PYR	OXT-C-CA-O3
2	E	500	NAD	O4B-C4B-C5B-O5B
2	B	500	NAD	O4B-C4B-C5B-O5B
3	A	501	PYR	O-C-CA-CB
3	D	501	PYR	O-C-CA-CB

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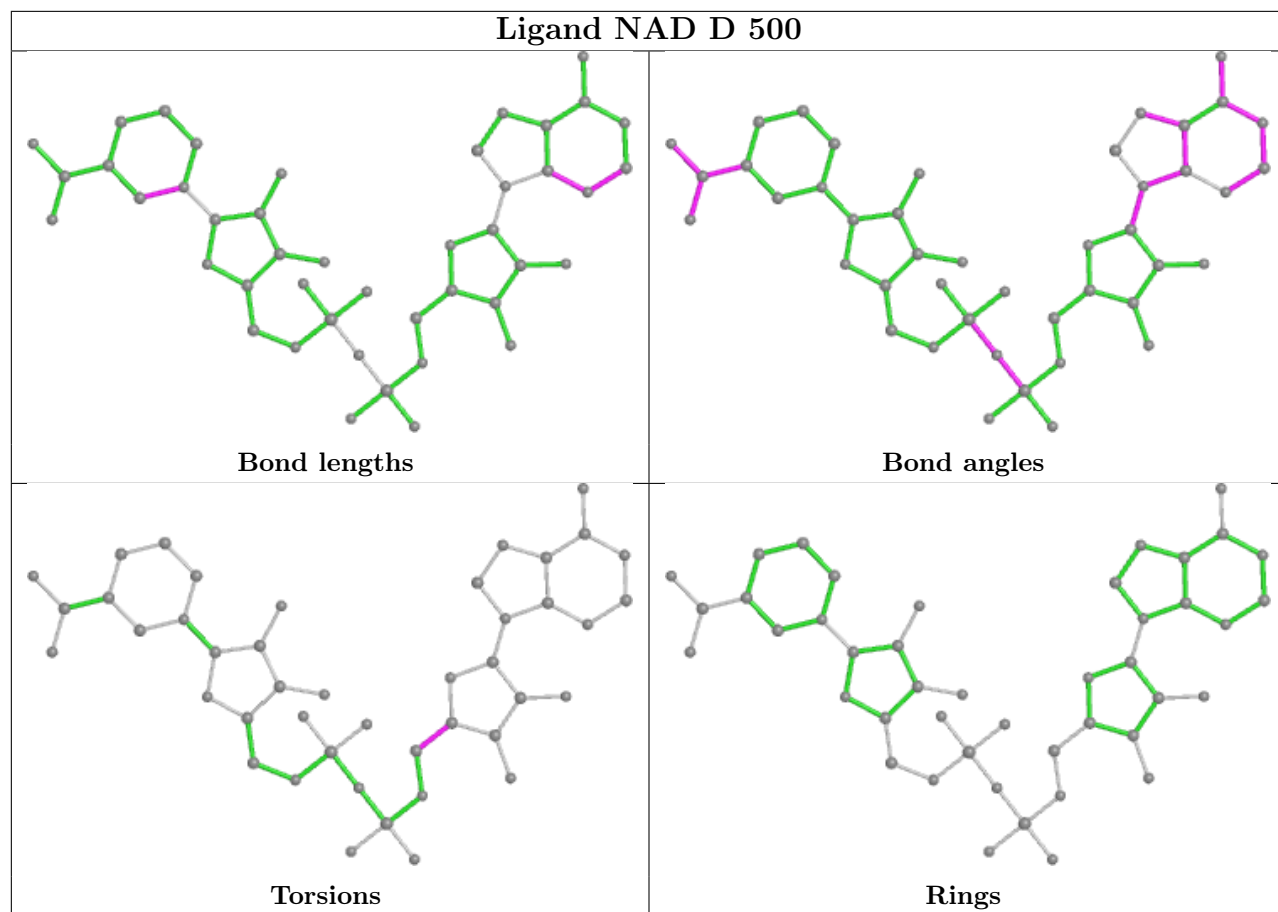
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Mol	Chain	Res	Type	Atoms
2	A	500	NAD	O4B-C4B-C5B-O5B
2	D	500	NAD	O4B-C4B-C5B-O5B
2	F	500	NAD	C5D-O5D-PN-O2N
2	C	500	NAD	O4B-C4B-C5B-O5B
2	F	500	NAD	O4B-C4B-C5B-O5B

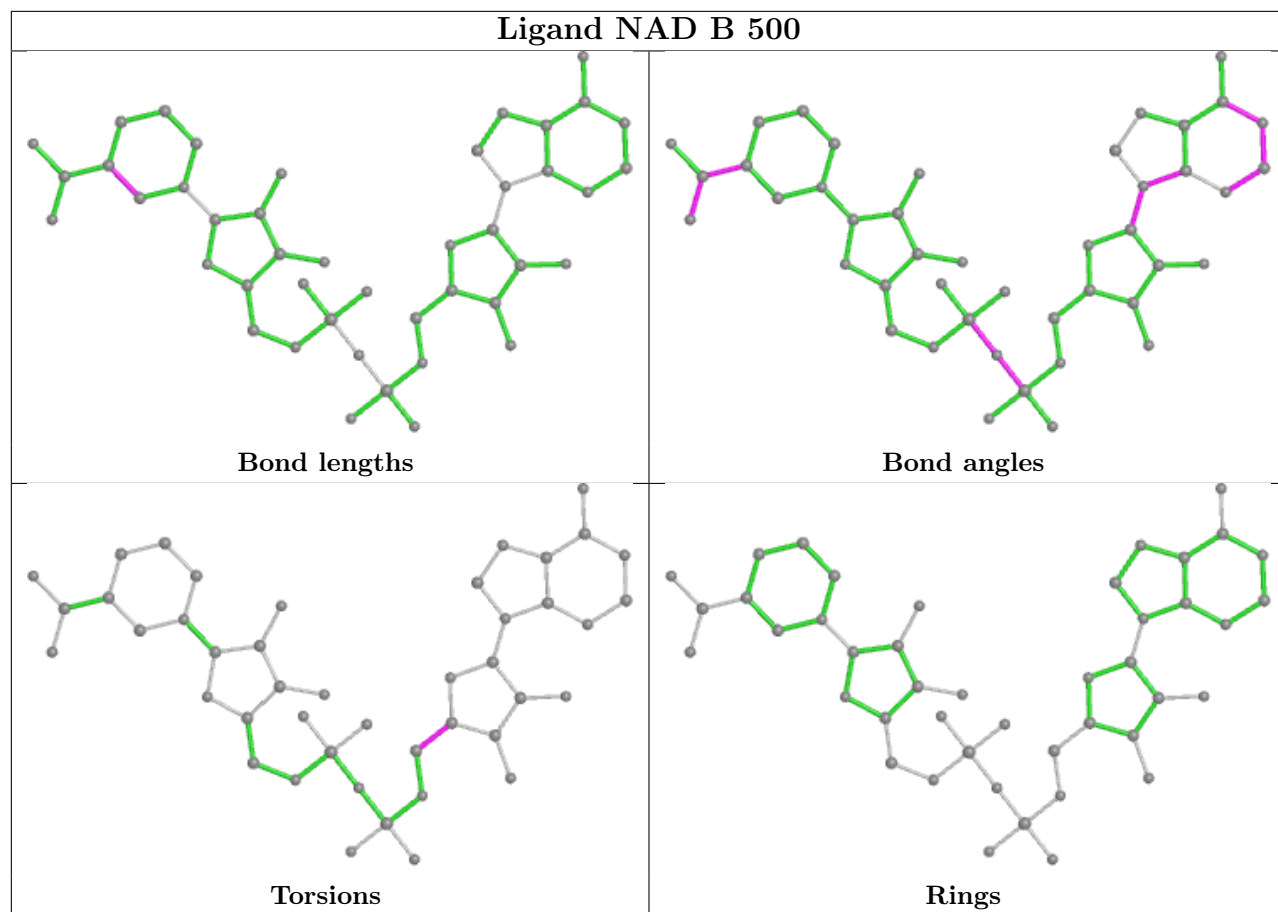
There are no ring outliers.

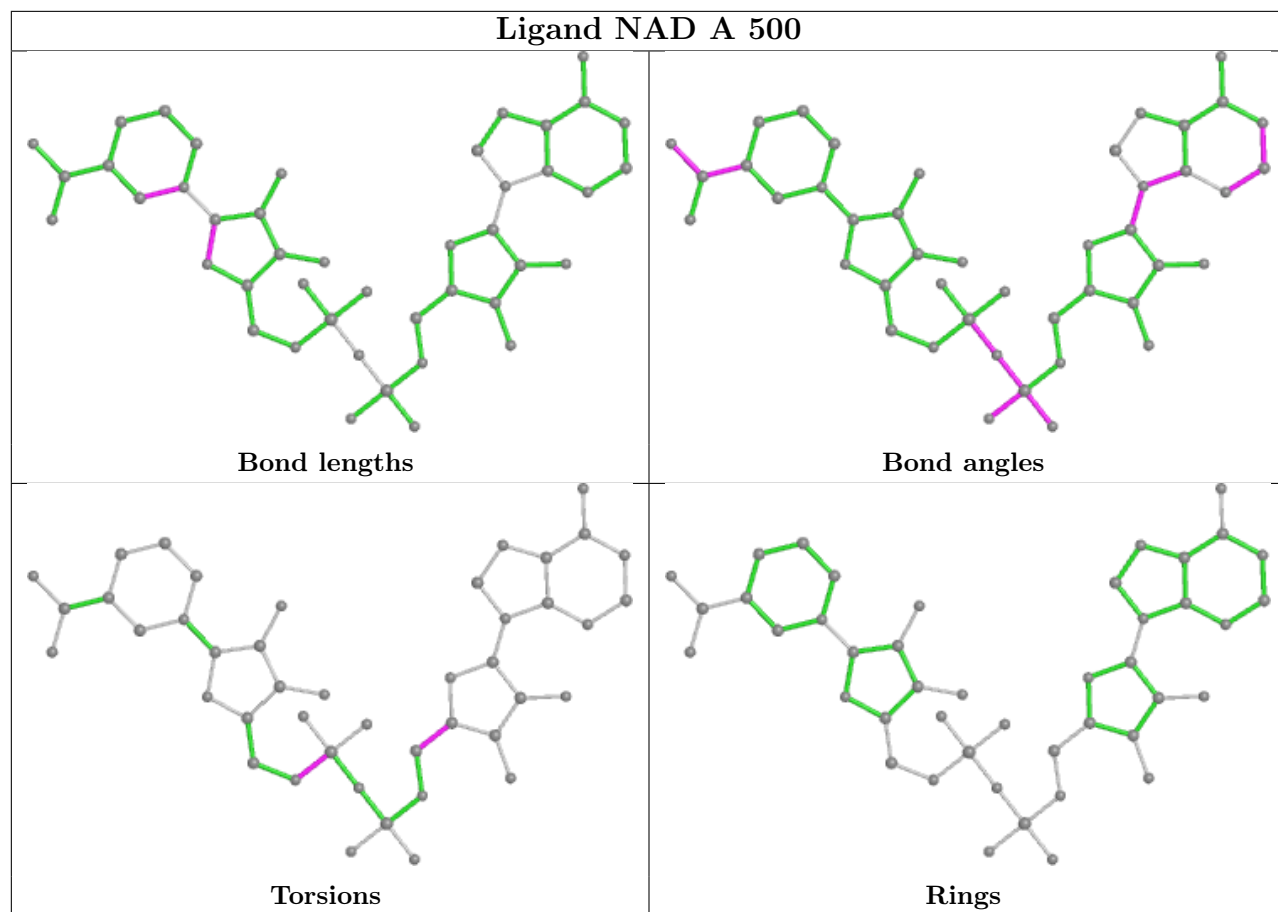
No monomer is involved in short contacts.

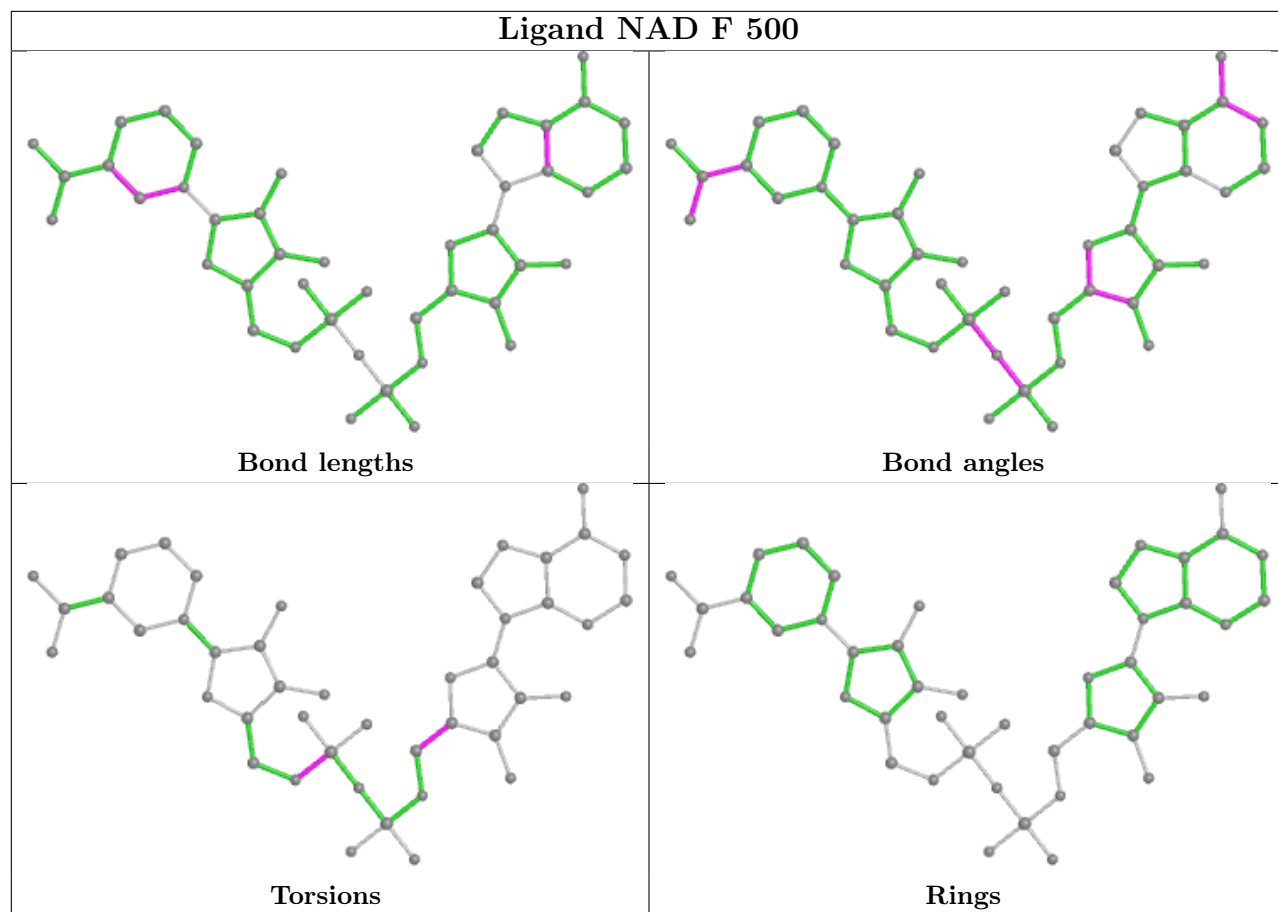
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

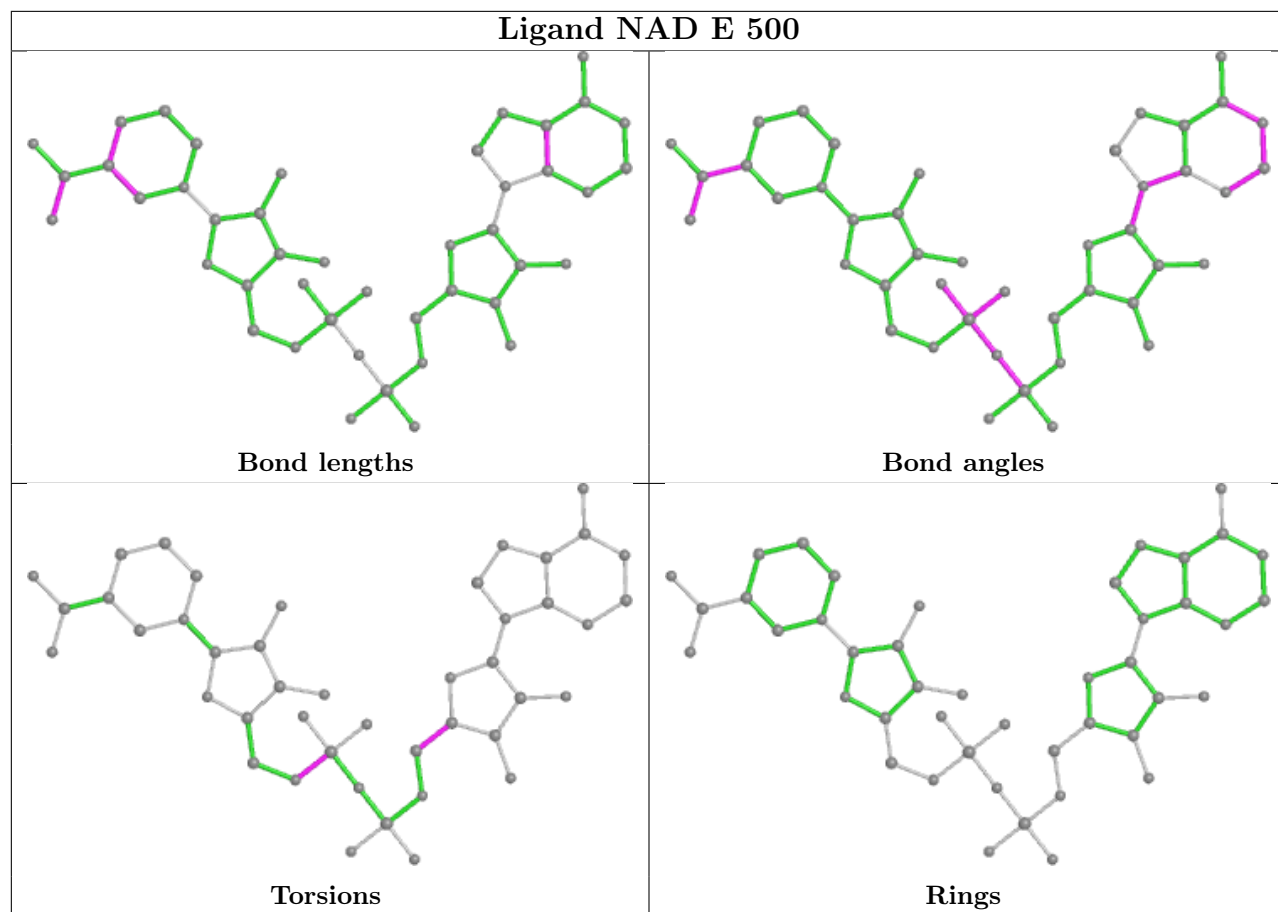


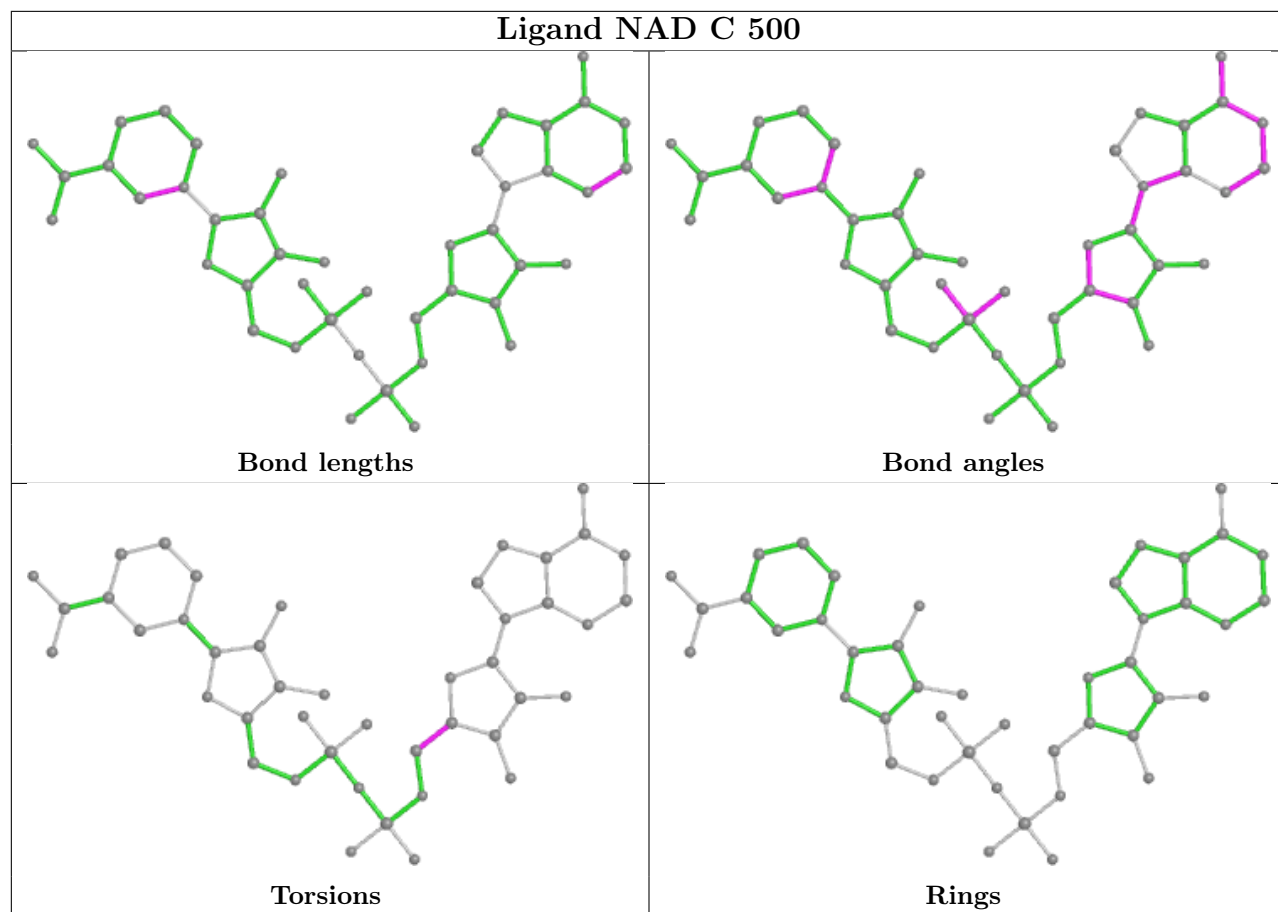












## 5.7 Other polymers [i](#)

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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

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	320/321 (99%)	-0.51	1 (0%) 94 94	8, 18, 38, 57	0
1	B	321/321 (100%)	-0.47	2 (0%) 89 91	8, 18, 38, 92	0
1	C	320/321 (99%)	-0.47	2 (0%) 89 91	9, 18, 41, 71	0
1	D	320/321 (99%)	-0.47	1 (0%) 94 94	9, 17, 41, 86	0
1	E	320/321 (99%)	-0.31	5 (1%) 72 75	9, 21, 51, 82	0
1	F	319/321 (99%)	-0.46	3 (0%) 84 86	9, 18, 42, 80	0
All	All	1920/1926 (99%)	-0.45	14 (0%) 87 89	8, 18, 42, 92	0

All (14) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	1	HIS	4.5
1	E	321	LEU	4.2
1	C	321	LEU	4.2
1	D	321	LEU	4.0
1	F	1	HIS	3.4
1	E	264	ILE	2.7
1	A	321	LEU	2.6
1	B	321	LEU	2.6
1	E	2	MET	2.3
1	E	269	VAL	2.2
1	F	319	PRO	2.2
1	F	2	MET	2.2
1	E	318	LEU	2.2
1	C	265	GLU	2.1

### 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](#)

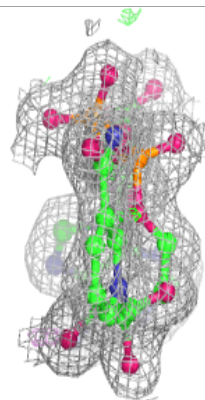
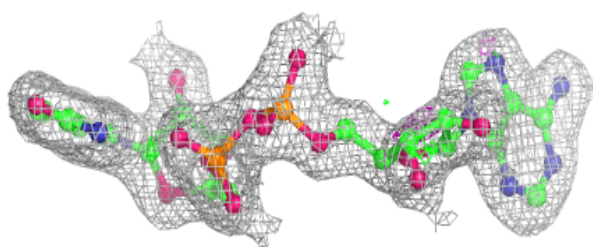
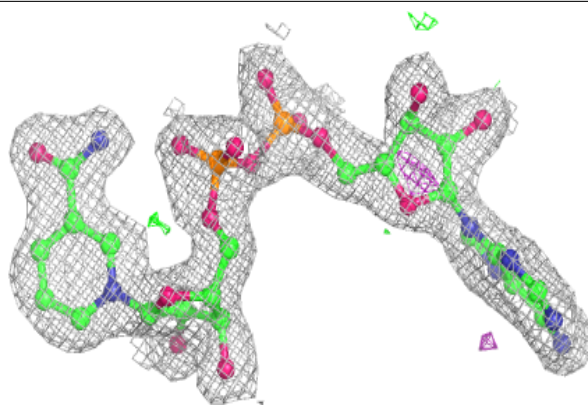
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 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
6	NA	E	503	1/1	0.67	0.18	33,33,33,33	0
4	BME	B	502	4/4	0.68	0.29	56,60,66,71	0
5	ACT	E	502	4/4	0.78	0.15	36,36,37,41	0
4	BME	A	502	4/4	0.85	0.21	42,44,48,52	0
5	ACT	A	503	4/4	0.85	0.16	28,28,29,35	0
3	PYR	E	501	6/6	0.87	0.21	26,32,35,37	0
5	ACT	B	503	4/4	0.87	0.15	29,31,37,40	0
6	NA	A	504	1/1	0.89	0.17	29,29,29,29	0
3	PYR	C	501	6/6	0.90	0.16	27,29,33,33	0
3	PYR	D	501	6/6	0.90	0.14	22,23,27,28	0
6	NA	F	502	1/1	0.91	0.13	28,28,28,28	0
6	NA	B	504	1/1	0.92	0.11	30,30,30,30	0
3	PYR	B	501	6/6	0.92	0.19	21,25,28,31	0
3	PYR	F	501	6/6	0.92	0.15	21,25,26,27	0
3	PYR	A	501	6/6	0.94	0.13	18,20,22,27	0
6	NA	C	502	1/1	0.97	0.07	21,21,21,21	0
2	NAD	E	500	44/44	0.97	0.12	17,20,22,24	0
2	NAD	B	500	44/44	0.97	0.11	15,18,20,23	0
2	NAD	C	500	44/44	0.98	0.08	15,17,18,20	0
2	NAD	D	500	44/44	0.98	0.08	12,14,16,17	0
6	NA	D	502	1/1	0.98	0.06	20,20,20,20	0
2	NAD	A	500	44/44	0.98	0.09	14,15,17,19	0
2	NAD	F	500	44/44	0.98	0.09	14,17,18,20	0

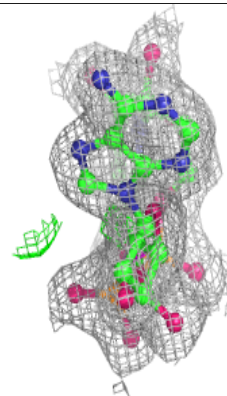
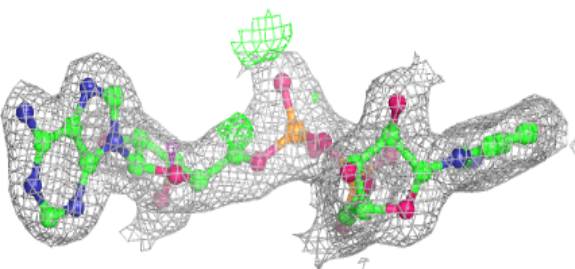
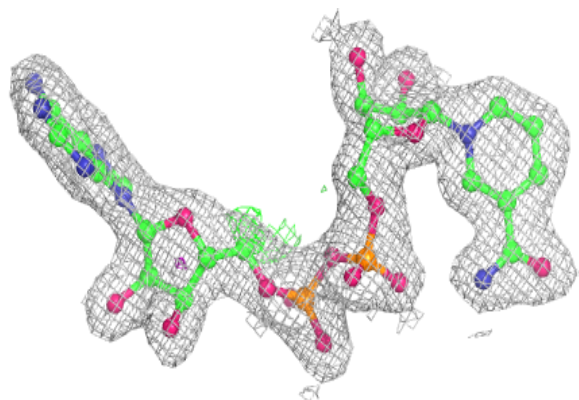
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

**Electron density around NAD E 500:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

**Electron density around NAD B 500:**

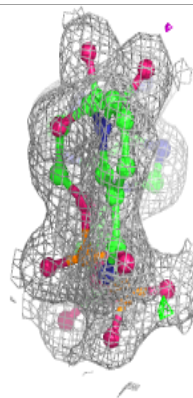
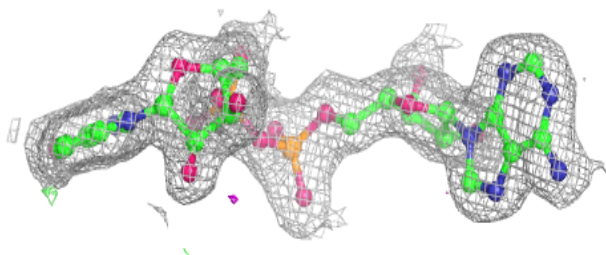
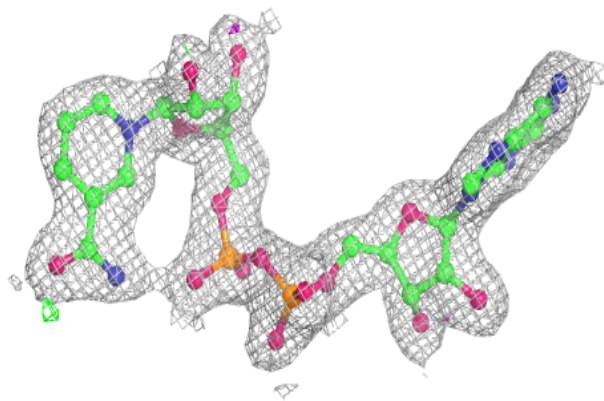
$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



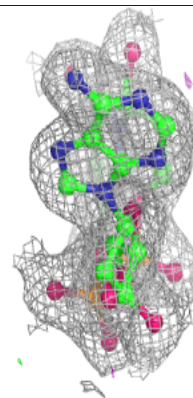
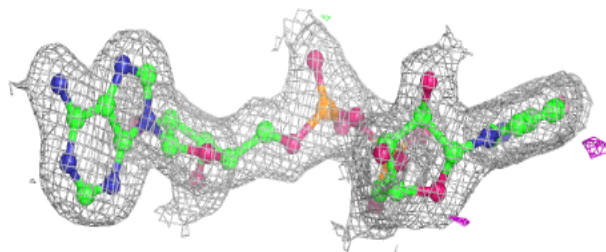
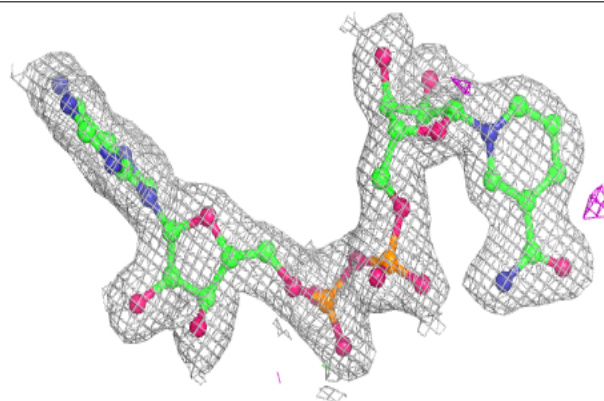


**Electron density around NAD C 500:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

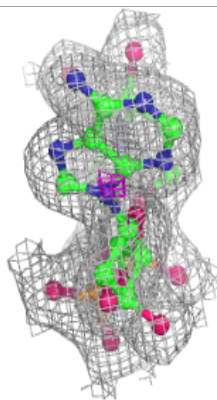
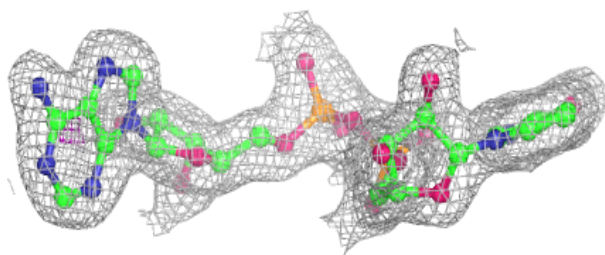
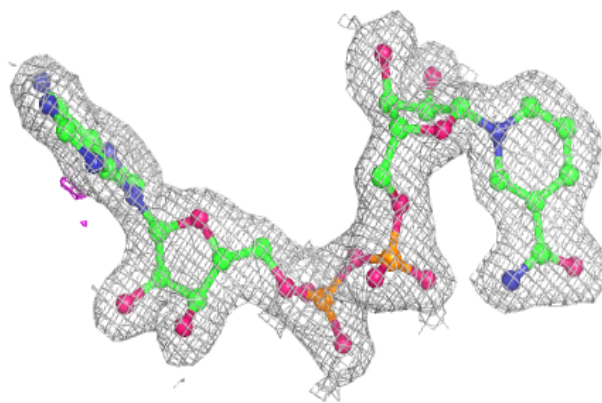
**Electron density around NAD D 500:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

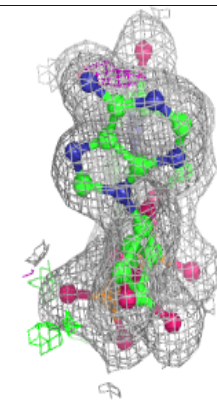
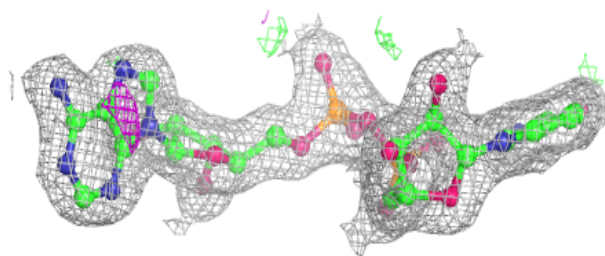
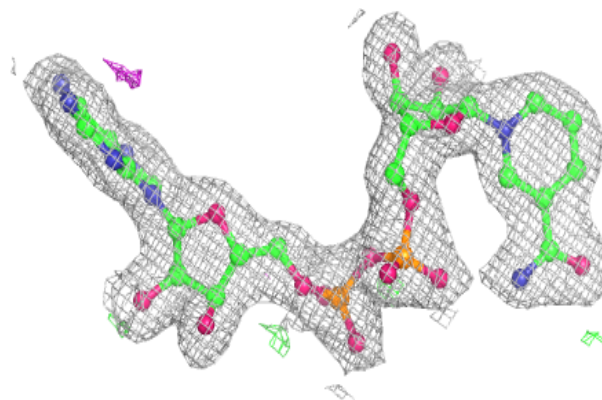


**Electron density around NAD A 500:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)

**Electron density around NAD F 500:**

$2mF_o-DF_c$  (at 0.7 rmsd) in gray  
 $mF_o-DF_c$  (at 3 rmsd) in purple (negative)  
and green (positive)



## 6.5 Other polymers [i](#)

There are no such residues in this entry.