



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 02:07 AM UTC

PDB ID : 4YRB / pdb_00004yrb
Title : mouse TDH mutant R180K with NAD⁺ bound
Authors : He, C.; Li, F.
Deposited on : 2015-03-14
Resolution : 3.25 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) : 2.0
EDS : 3.0
Buster-report : wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

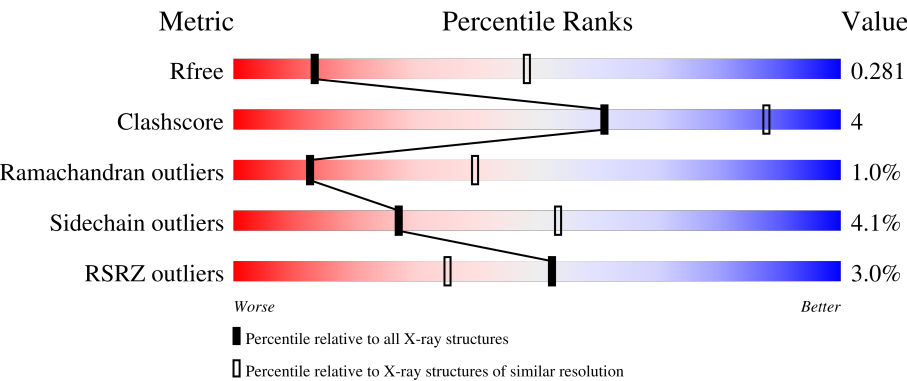
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.25 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}	180053	1605 (3.30-3.22)
Clashscore	190562	1660 (3.30-3.22)
Ramachandran outliers	187476	1630 (3.30-3.22)
Sidechain outliers	187428	1629 (3.30-3.22)
RSRZ outliers	180081	1605 (3.30-3.22)

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 $\leq 5\%$. 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	329	3% 54% 8% • 37%
1	B	329	% 55% 10% 35%
1	C	329	3% 62% 13% • 24%
1	D	329	2% 63% 7% 29%
1	E	329	2% 55% 11% • 32%

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Mol	Chain	Length	Quality of chain
1	F	329	% 54% 9% 37%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 10856 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, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	206	Total	C	N	O	S	0	0	0
			1645	1060	288	290	7			
1	B	215	Total	C	N	O	S	0	0	0
			1704	1098	294	303	9			
1	C	249	Total	C	N	O	S	0	0	0
			1966	1262	343	350	11			
1	D	232	Total	C	N	O	S	0	0	0
			1844	1186	321	328	9			
1	E	223	Total	C	N	O	S	0	0	0
			1765	1138	307	311	9			
1	F	208	Total	C	N	O	S	0	0	0
			1668	1074	291	296	7			

There are 18 discrepancies between the modelled and reference sequences:

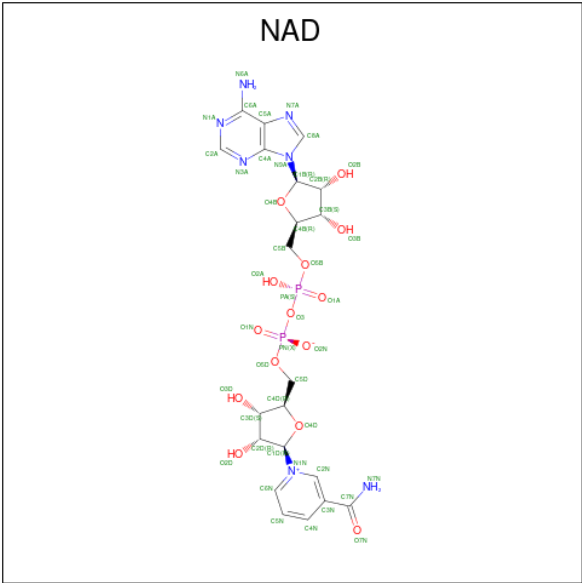
Chain	Residue	Modelled	Actual	Comment	Reference
A	45	HIS	-	expression tag	UNP Q8K3F7
A	46	MET	-	expression tag	UNP Q8K3F7
A	180	LYS	ARG	engineered mutation	UNP Q8K3F7
B	45	HIS	-	expression tag	UNP Q8K3F7
B	46	MET	-	expression tag	UNP Q8K3F7
B	180	LYS	ARG	engineered mutation	UNP Q8K3F7
C	45	HIS	-	expression tag	UNP Q8K3F7
C	46	MET	-	expression tag	UNP Q8K3F7
C	180	LYS	ARG	engineered mutation	UNP Q8K3F7
D	45	HIS	-	expression tag	UNP Q8K3F7
D	46	MET	-	expression tag	UNP Q8K3F7
D	180	LYS	ARG	engineered mutation	UNP Q8K3F7
E	45	HIS	-	expression tag	UNP Q8K3F7
E	46	MET	-	expression tag	UNP Q8K3F7
E	180	LYS	ARG	engineered mutation	UNP Q8K3F7
F	45	HIS	-	expression tag	UNP Q8K3F7
F	46	MET	-	expression tag	UNP Q8K3F7

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Chain	Residue	Modelled	Actual	Comment	Reference
F	180	LYS	ARG	engineered mutation	UNP Q8K3F7

- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (CCD ID: NAD) (formula: C₂₁H₂₇N₇O₁₄P₂).

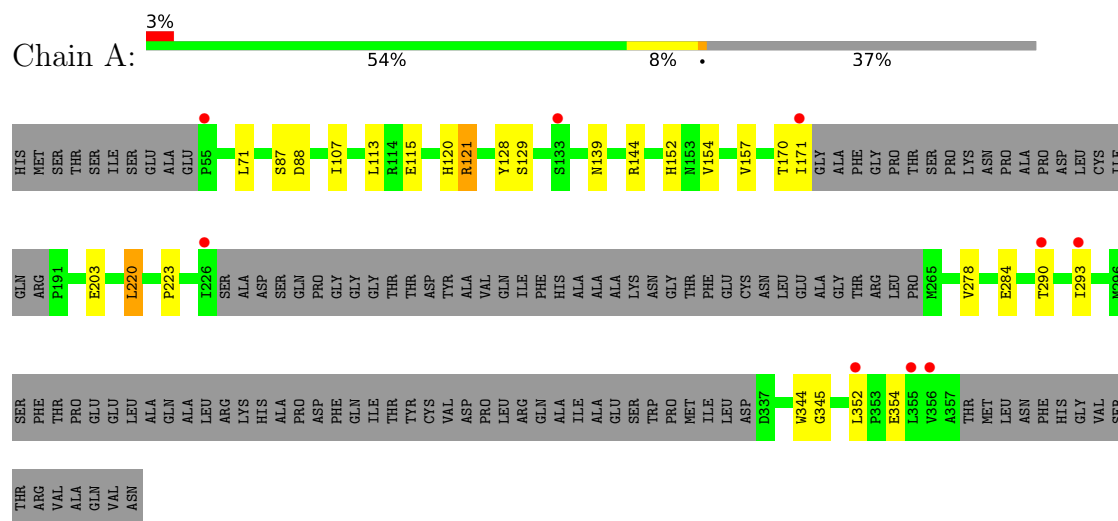


Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	B	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	C	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	D	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	E	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	F	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

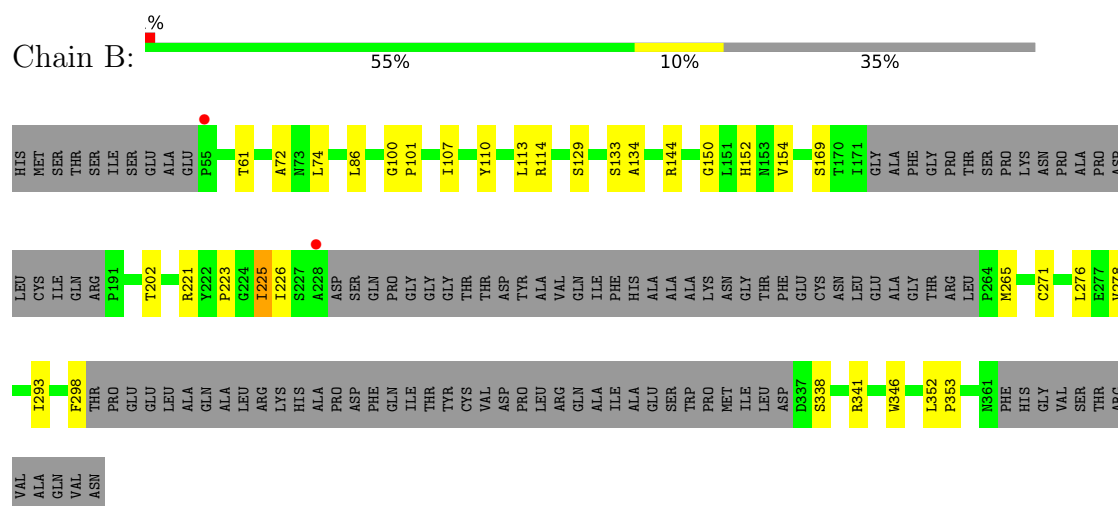
3 Residue-property plots [i](#)

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, mitochondrial

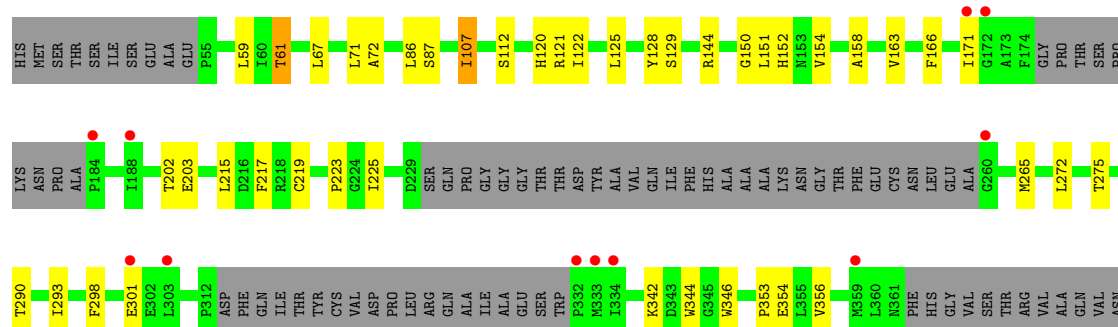


- Molecule 1: L-threonine 3-dehydrogenase, mitochondrial

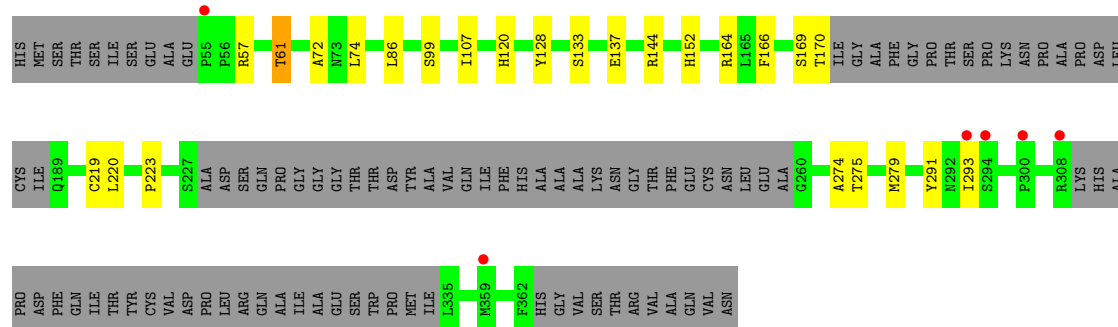


- Molecule 1: L-threonine 3-dehydrogenase, mitochondrial

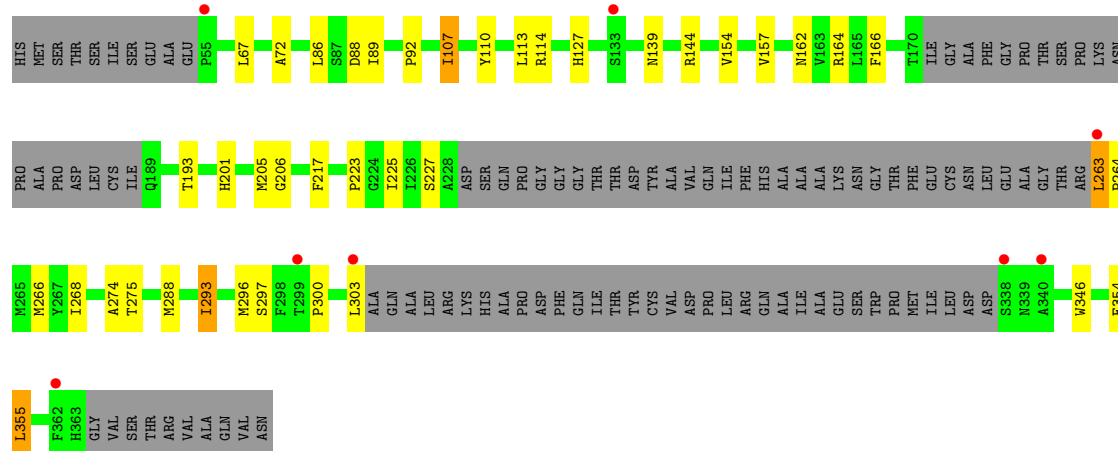




- Molecule 1: L-threonine 3-dehydrogenase, mitochondrial

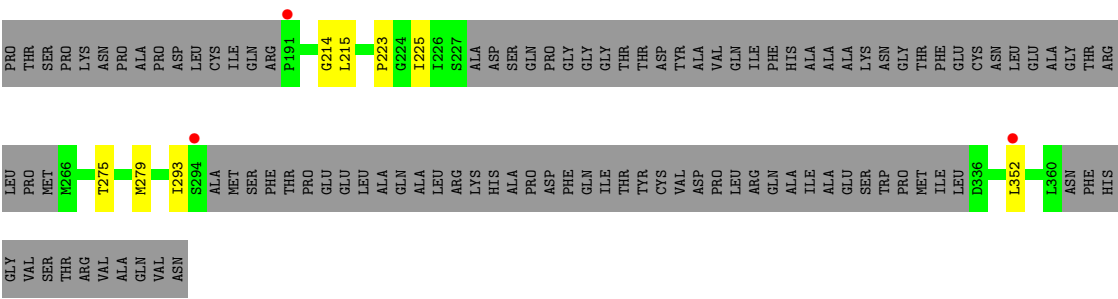


- Molecule 1: L-threonine 3-dehydrogenase, mitochondrial



- Molecule 1: L-threonine 3-dehydrogenase, mitochondrial





4 Data and refinement statistics

Property	Value	Source
Space group	P 2 ₁ 2 ₁ 2 ₁	Depositor
Cell constants a, b, c, α , β , γ	74.24Å 154.05Å 199.19Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.12 – 3.25 47.12 – 3.25	Depositor EDS
% Data completeness (in resolution range)	97.0 (47.12-3.25) 97.0 (47.12-3.25)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.19 (at 3.25Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.228 , 0.285 0.226 , 0.281	Depositor DCC
R_{free} test set	1772 reflections (4.81%)	wwPDB-VP
Wilson B-factor (Å ²)	70.8	Xtriage
Anisotropy	0.069	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 46.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	10856	wwPDB-VP
Average B, all atoms (Å ²)	77.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.59% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.45	0/1684	0.75	0/2283
1	B	0.43	0/1745	0.77	2/2367 (0.1%)
1	C	0.45	0/2013	0.75	0/2729
1	D	0.44	0/1887	0.75	0/2559
1	E	0.46	0/1808	0.77	0/2454
1	F	0.43	0/1707	0.72	0/2313
All	All	0.45	0/10844	0.75	2/14705 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	100	GLY	CA-C-N	5.03	126.13	119.84
1	B	100	GLY	C-N-CA	5.03	126.13	119.84

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	1645	0	1638	13	0
1	B	1704	0	1688	19	0
1	C	1966	0	1955	22	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	D	1844	0	1835	11	0
1	E	1765	0	1752	17	0
1	F	1668	0	1669	15	0
2	A	44	0	26	3	0
2	B	44	0	26	2	0
2	C	44	0	26	1	0
2	D	44	0	26	0	0
2	E	44	0	26	0	0
2	F	44	0	26	1	0
All	All	10856	0	10693	91	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 4.

All (91) 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:F:164:ARG:NH2	1:F:279:MET:O	2.09	0.86
1:A:121:ARG:NH2	1:E:92:PRO:O	2.17	0.76
1:D:164:ARG:NH2	1:D:279:MET:O	2.29	0.66
1:E:107:ILE:HD11	1:E:154:VAL:HG23	1.81	0.62
1:C:144:ARG:HD2	1:D:152:HIS:CD2	2.37	0.58
1:C:152:HIS:CD2	1:D:144:ARG:HD2	2.39	0.58
1:B:226:ILE:HD11	1:B:265:MET:SD	2.45	0.57
1:A:220:LEU:HD21	1:A:278:VAL:HG11	1.88	0.56
1:D:57:ARG:NH1	1:D:120:HIS:O	2.37	0.56
1:C:107:ILE:HG23	1:C:150:GLY:HA2	1.88	0.56
1:B:225:ILE:CD1	1:B:271:CYS:SG	2.94	0.56
1:E:67:LEU:HD21	1:E:225:ILE:HG21	1.88	0.55
1:B:74:LEU:HD21	1:B:276:LEU:HD22	1.88	0.55
1:B:110:TYR:CE2	1:B:114:ARG:HD2	2.43	0.53
1:E:296:MET:HE1	1:E:355:LEU:HD22	1.92	0.52
1:F:158:ALA:HA	1:F:163:VAL:HB	1.92	0.51
1:E:107:ILE:HD11	1:E:154:VAL:CG2	2.41	0.50
1:C:344:TRP:CZ3	1:C:346:TRP:HB2	2.47	0.49
1:E:127:HIS:ND1	1:E:154:VAL:HG21	2.28	0.49
1:F:72:ALA:HB2	1:F:86:LEU:HD13	1.94	0.48
1:A:152:HIS:CD2	1:B:144:ARG:HD2	2.48	0.48
1:B:225:ILE:HD13	1:B:271:CYS:SG	2.53	0.48
1:D:61:THR:O	1:D:128:TYR:HB2	2.13	0.48
1:A:71:LEU:HD22	1:A:128:TYR:CE2	2.48	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:170:THR:O	1:A:171:ILE:C	2.56	0.48
1:F:129:SER:HB2	2:F:1001:NAD:C4A	2.43	0.48
1:B:129:SER:HB2	2:B:1001:NAD:N3A	2.28	0.48
1:E:88:ASP:OD1	1:E:89:ILE:N	2.47	0.47
1:A:293:ILE:HD11	1:A:344:TRP:CZ2	2.50	0.47
1:C:151:LEU:CD2	1:C:202:THR:HA	2.45	0.47
1:D:166:PHE:CZ	1:D:275:THR:HG23	2.49	0.47
1:D:169:SER:HB2	1:D:219:CYS:SG	2.56	0.46
1:A:113:LEU:HB3	1:A:157:VAL:HG21	1.97	0.46
1:B:352:LEU:HD23	1:B:352:LEU:C	2.41	0.46
1:C:265:MET:HG3	1:C:298:PHE:CZ	2.51	0.46
1:C:166:PHE:CZ	1:C:275:THR:HG23	2.51	0.45
1:F:214:GLY:O	1:F:215:LEU:C	2.59	0.45
1:B:107:ILE:HD13	1:B:113:LEU:HD21	1.98	0.45
1:E:274:ALA:HB2	1:E:346:TRP:CZ3	2.52	0.45
1:C:215:LEU:O	1:C:217:PHE:N	2.49	0.45
1:A:144:ARG:HD2	1:B:152:HIS:CD2	2.52	0.45
1:D:133:SER:O	1:D:137:GLU:HG2	2.17	0.45
1:E:206:GLY:HA3	1:E:217:PHE:CZ	2.52	0.45
1:F:145:ASP:O	1:F:149:THR:HB	2.16	0.45
1:C:71:LEU:HA	1:C:272:LEU:HD22	1.97	0.45
1:C:219:CYS:SG	1:C:290:THR:HG23	2.57	0.45
1:D:220:LEU:HD23	1:D:291:TYR:HB2	1.99	0.45
1:C:72:ALA:HB2	1:C:86:LEU:HD13	1.98	0.44
1:C:107:ILE:HB	2:C:1001:NAD:N1A	2.32	0.44
1:F:166:PHE:CZ	1:F:275:THR:HG23	2.52	0.44
1:B:341:ARG:HG2	1:B:346:TRP:O	2.17	0.44
1:A:129:SER:HB2	2:A:1001:NAD:C4A	2.47	0.44
1:E:110:TYR:CE2	1:E:114:ARG:HD2	2.53	0.44
1:C:158:ALA:HA	1:C:163:VAL:HB	2.00	0.44
1:B:352:LEU:O	1:B:353:PRO:C	2.60	0.44
1:C:71:LEU:HD22	1:C:128:TYR:CZ	2.53	0.43
1:E:201:HIS:CE1	1:E:205:MET:CG	3.01	0.43
1:F:67:LEU:HD21	1:F:225:ILE:HG21	2.00	0.43
1:F:76:ARG:NH2	1:F:101:PRO:O	2.51	0.43
1:B:169:SER:HB3	1:B:221:ARG:HG2	2.00	0.43
1:C:59:LEU:HB3	1:C:122:ILE:HG21	1.99	0.43
1:D:274:ALA:CB	1:D:293:ILE:CD1	2.97	0.43
1:B:265:MET:HG3	1:B:298:PHE:CZ	2.54	0.43
1:C:203:GLU:OE1	1:C:290:THR:HG21	2.18	0.43
1:A:88:ASP:OD1	2:A:1001:NAD:O2B	2.24	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:144:ARG:HD2	1:F:152:HIS:CD2	2.53	0.43
1:F:92:PRO:HB2	1:F:96:VAL:HG23	2.00	0.43
1:A:170:THR:CG2	2:A:1001:NAD:H6N	2.49	0.43
1:E:72:ALA:HB2	1:E:86:LEU:HD13	2.00	0.42
1:F:110:TYR:CE2	1:F:114:ARG:HD2	2.54	0.42
1:B:74:LEU:C	1:B:74:LEU:HD23	2.44	0.42
1:B:72:ALA:HB2	1:B:86:LEU:HD13	2.02	0.42
1:B:150:GLY:O	1:B:154:VAL:HG23	2.19	0.42
1:C:125:LEU:HB2	1:C:163:VAL:HG11	2.02	0.42
1:C:61:THR:HG22	1:C:129:SER:HB3	2.02	0.41
1:F:56:PRO:HD2	1:F:79:PHE:CD1	2.55	0.41
1:B:133:SER:O	1:B:134:ALA:C	2.64	0.41
1:F:64:LEU:HD21	1:F:92:PRO:HB3	2.03	0.41
1:E:113:LEU:HB2	1:E:157:VAL:HG21	2.01	0.41
1:E:227:SER:HB3	1:E:268:ILE:HB	2.02	0.41
1:A:120:HIS:O	1:A:121:ARG:C	2.63	0.41
1:B:129:SER:HB2	2:B:1001:NAD:C4A	2.51	0.41
1:C:151:LEU:HD22	1:C:202:THR:HA	2.03	0.41
1:F:92:PRO:HB2	1:F:96:VAL:CG2	2.51	0.41
1:A:203:GLU:CD	1:A:290:THR:HG21	2.46	0.41
1:E:166:PHE:CZ	1:E:275:THR:HG23	2.56	0.41
1:C:120:HIS:O	1:C:121:ARG:C	2.64	0.41
1:D:72:ALA:HB2	1:D:86:LEU:HD13	2.01	0.41
1:C:67:LEU:HD21	1:C:225:ILE:HG21	2.03	0.40
1:C:353:PRO:O	1:C:356:VAL:HG12	2.21	0.40
1:E:263:LEU:HG	1:E:264:PRO:HD2	2.04	0.40

There are no symmetry-related clashes.

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	198/329 (60%)	183 (92%)	13 (7%)	2 (1%)	12	40
1	B	207/329 (63%)	189 (91%)	16 (8%)	2 (1%)	12	40
1	C	241/329 (73%)	220 (91%)	20 (8%)	1 (0%)	30	59
1	D	224/329 (68%)	209 (93%)	14 (6%)	1 (0%)	30	59
1	E	215/329 (65%)	197 (92%)	13 (6%)	5 (2%)	5	24
1	F	200/329 (61%)	184 (92%)	14 (7%)	2 (1%)	12	40
All	All	1285/1974 (65%)	1182 (92%)	90 (7%)	13 (1%)	12	40

All (13) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	300	PRO
1	A	345	GLY
1	E	162	ASN
1	E	223	PRO
1	A	223	PRO
1	C	223	PRO
1	D	223	PRO
1	E	266	MET
1	E	293	ILE
1	F	223	PRO
1	B	101	PRO
1	B	223	PRO
1	F	93	PRO

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	175/277 (63%)	165 (94%)	10 (6%)	18	46
1	B	182/277 (66%)	176 (97%)	6 (3%)	33	57
1	C	209/277 (76%)	199 (95%)	10 (5%)	23	50
1	D	197/277 (71%)	192 (98%)	5 (2%)	42	63

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	E	188/277 (68%)	177 (94%)	11 (6%)	18	45
1	F	180/277 (65%)	176 (98%)	4 (2%)	45	65
All	All	1131/1662 (68%)	1085 (96%)	46 (4%)	27	53

All (46) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	87	SER
1	A	107	ILE
1	A	115	GLU
1	A	121	ARG
1	A	139	ASN
1	A	154	VAL
1	A	220	LEU
1	A	284	GLU
1	A	352	LEU
1	A	354	GLU
1	B	61	THR
1	B	202	THR
1	B	225	ILE
1	B	278	VAL
1	B	293	ILE
1	B	338	SER
1	C	61	THR
1	C	87	SER
1	C	107	ILE
1	C	112	SER
1	C	154	VAL
1	C	171	ILE
1	C	293	ILE
1	C	301	GLU
1	C	342	LYS
1	C	354	GLU
1	D	61	THR
1	D	74	LEU
1	D	99	SER
1	D	107	ILE
1	D	170	THR
1	E	107	ILE
1	E	139	ASN
1	E	164	ARG

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Mol	Chain	Res	Type
1	E	193	THR
1	E	263	LEU
1	E	288	MET
1	E	293	ILE
1	E	297	SER
1	E	303	LEU
1	E	354	GLU
1	E	355	LEU
1	F	123	SER
1	F	133	SER
1	F	293	ILE
1	F	352	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	98	HIS
1	A	153	ASN
1	A	339	ASN
1	B	66	GLN
1	B	153	ASN
1	B	361	ASN
1	C	120	HIS
1	C	153	ASN
1	D	95	HIS
1	D	120	HIS
1	D	153	ASN
1	E	73	ASN
1	E	153	ASN
1	E	201	HIS
1	F	95	HIS
1	F	153	ASN
1	F	348	HIS

5.3.3 RNA ⓘ

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](#)

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	$\# Z > 2$
2	NAD	E	1001	-	46,48,48	1.17	4 (8%)	64,73,73	1.70	12 (18%)
2	NAD	A	1001	-	46,48,48	1.20	7 (15%)	64,73,73	1.64	12 (18%)
2	NAD	F	1001	-	46,48,48	1.20	8 (17%)	64,73,73	1.67	11 (17%)
2	NAD	B	1001	-	46,48,48	1.20	5 (10%)	64,73,73	1.64	9 (14%)
2	NAD	D	1001	-	46,48,48	1.19	5 (10%)	64,73,73	1.69	11 (17%)
2	NAD	C	1001	-	46,48,48	1.22	5 (10%)	64,73,73	1.68	13 (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	E	1001	-	-	4/30/62/62	0/5/5/5
2	NAD	A	1001	-	-	2/30/62/62	0/5/5/5
2	NAD	F	1001	-	-	7/30/62/62	0/5/5/5
2	NAD	B	1001	-	-	3/30/62/62	0/5/5/5
2	NAD	D	1001	-	-	6/30/62/62	0/5/5/5
2	NAD	C	1001	-	-	6/30/62/62	0/5/5/5

All (34) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	1001	NAD	C5A-C4A	4.63	1.47	1.39
2	D	1001	NAD	C5A-C4A	4.58	1.47	1.39
2	C	1001	NAD	C5A-C4A	4.56	1.47	1.39
2	B	1001	NAD	C5A-C4A	4.51	1.47	1.39
2	A	1001	NAD	C5A-C4A	4.38	1.46	1.39
2	F	1001	NAD	C5A-C4A	4.31	1.46	1.39
2	F	1001	NAD	C5A-C6A	2.73	1.48	1.41
2	D	1001	NAD	C5A-C6A	2.72	1.48	1.41
2	C	1001	NAD	C5A-C6A	2.72	1.48	1.41
2	E	1001	NAD	C5A-C6A	2.65	1.48	1.41
2	A	1001	NAD	C5A-C6A	2.65	1.48	1.41
2	C	1001	NAD	C8A-N7A	2.58	1.36	1.31
2	B	1001	NAD	C8A-N7A	2.53	1.36	1.31
2	F	1001	NAD	C8A-N7A	2.52	1.36	1.31
2	E	1001	NAD	C8A-N7A	2.50	1.36	1.31
2	B	1001	NAD	C5A-C6A	2.50	1.47	1.41
2	A	1001	NAD	C8A-N7A	2.47	1.36	1.31
2	C	1001	NAD	C5A-N7A	-2.46	1.34	1.39
2	B	1001	NAD	O4D-C1D	2.46	1.44	1.40
2	D	1001	NAD	C8A-N7A	2.46	1.36	1.31
2	B	1001	NAD	C5A-N7A	-2.45	1.34	1.39
2	F	1001	NAD	O4D-C1D	2.37	1.44	1.40
2	F	1001	NAD	C5A-N7A	-2.31	1.34	1.39
2	E	1001	NAD	C5A-N7A	-2.27	1.34	1.39
2	F	1001	NAD	PA-O3	2.27	1.61	1.59
2	D	1001	NAD	C5A-N7A	-2.25	1.35	1.39
2	A	1001	NAD	C5A-N7A	-2.21	1.35	1.39
2	A	1001	NAD	PN-O3	2.20	1.61	1.59
2	A	1001	NAD	C4A-N9A	-2.18	1.33	1.37
2	D	1001	NAD	O4D-C1D	2.12	1.43	1.40
2	A	1001	NAD	O4D-C1D	2.08	1.43	1.40
2	F	1001	NAD	PN-O3	2.04	1.61	1.59
2	C	1001	NAD	PN-O3	2.02	1.61	1.59
2	F	1001	NAD	C4A-N9A	-2.00	1.33	1.37

All (68) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	1001	NAD	C5A-C4A-N3A	-6.25	118.11	126.72
2	B	1001	NAD	C5A-C4A-N3A	-5.98	118.48	126.72
2	F	1001	NAD	C5A-C4A-N3A	-5.75	118.80	126.72
2	C	1001	NAD	C5A-C4A-N3A	-5.59	119.03	126.72

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	1001	NAD	C5A-C4A-N3A	-5.55	119.08	126.72
2	A	1001	NAD	C5A-C4A-N3A	-5.23	119.51	126.72
2	D	1001	NAD	N3A-C4A-N9A	4.73	135.21	127.17
2	B	1001	NAD	N3A-C4A-N9A	4.57	134.95	127.17
2	E	1001	NAD	N3A-C4A-N9A	4.45	134.73	127.17
2	A	1001	NAD	N3A-C4A-N9A	4.30	134.48	127.17
2	C	1001	NAD	N3A-C4A-N9A	4.29	134.46	127.17
2	F	1001	NAD	N3A-C4A-N9A	4.21	134.34	127.17
2	D	1001	NAD	C2A-N3A-C4A	4.18	122.03	111.83
2	C	1001	NAD	N3A-C2A-N1A	-4.11	122.37	128.58
2	F	1001	NAD	C2A-N3A-C4A	4.07	121.78	111.83
2	A	1001	NAD	N3A-C2A-N1A	-4.04	122.47	128.58
2	B	1001	NAD	C2A-N3A-C4A	4.03	121.67	111.83
2	D	1001	NAD	N3A-C2A-N1A	-4.01	122.51	128.58
2	E	1001	NAD	N3A-C2A-N1A	-3.98	122.56	128.58
2	F	1001	NAD	N3A-C2A-N1A	-3.97	122.56	128.58
2	C	1001	NAD	C2A-N3A-C4A	3.95	121.47	111.83
2	B	1001	NAD	N3A-C2A-N1A	-3.89	122.70	128.58
2	A	1001	NAD	C2A-N3A-C4A	3.88	121.30	111.83
2	E	1001	NAD	C2A-N3A-C4A	3.83	121.18	111.83
2	F	1001	NAD	C4A-C5A-N7A	-3.75	106.29	110.58
2	C	1001	NAD	C4A-C5A-N7A	-3.63	106.43	110.58
2	D	1001	NAD	C4A-C5A-N7A	-3.56	106.51	110.58
2	A	1001	NAD	C4A-N9A-C8A	3.50	109.41	105.74
2	E	1001	NAD	C4A-C5A-N7A	-3.46	106.62	110.58
2	F	1001	NAD	O4B-C1B-N9A	3.31	114.45	108.09
2	A	1001	NAD	C4A-C5A-N7A	-3.29	106.82	110.58
2	B	1001	NAD	O4B-C1B-N9A	3.28	114.40	108.09
2	C	1001	NAD	O4B-C1B-N9A	3.27	114.38	108.09
2	E	1001	NAD	C3N-C7N-N7N	3.15	121.62	117.74
2	B	1001	NAD	C4A-C5A-N7A	-3.13	107.00	110.58
2	E	1001	NAD	C4A-N9A-C8A	3.03	108.92	105.74
2	D	1001	NAD	O4B-C1B-N9A	3.02	113.88	108.09
2	C	1001	NAD	C5A-N7A-C8A	2.84	107.92	103.45
2	F	1001	NAD	C5A-N7A-C8A	2.78	107.82	103.45
2	E	1001	NAD	C5A-N7A-C8A	2.78	107.82	103.45
2	C	1001	NAD	C4A-N9A-C8A	2.76	108.64	105.74
2	D	1001	NAD	C5A-N7A-C8A	2.73	107.74	103.45
2	E	1001	NAD	O4B-C1B-N9A	2.71	113.30	108.09
2	A	1001	NAD	N9A-C8A-N7A	-2.62	110.21	113.94
2	A	1001	NAD	C5A-N7A-C8A	2.61	107.55	103.45
2	F	1001	NAD	C4A-N9A-C8A	2.60	108.47	105.74

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	1001	NAD	C6A-C5A-N7A	2.56	137.02	132.09
2	A	1001	NAD	C6A-C5A-N7A	2.48	136.88	132.09
2	E	1001	NAD	N9A-C8A-N7A	-2.46	110.44	113.94
2	E	1001	NAD	C2A-N1A-C6A	2.46	122.77	118.73
2	C	1001	NAD	N9A-C8A-N7A	-2.43	110.49	113.94
2	C	1001	NAD	C6A-C5A-N7A	2.42	136.76	132.09
2	C	1001	NAD	C4D-O4D-C1D	2.42	112.14	109.92
2	B	1001	NAD	C5A-N7A-C8A	2.39	107.21	103.45
2	F	1001	NAD	N9A-C8A-N7A	-2.39	110.55	113.94
2	C	1001	NAD	C2A-N1A-C6A	2.27	122.47	118.73
2	D	1001	NAD	C4A-N9A-C8A	2.27	108.12	105.74
2	A	1001	NAD	O4B-C1B-N9A	2.26	112.44	108.09
2	D	1001	NAD	C6A-C5A-N7A	2.25	136.42	132.09
2	E	1001	NAD	C6A-C5A-N7A	2.23	136.38	132.09
2	C	1001	NAD	C6N-N1N-C2N	-2.19	120.01	121.88
2	A	1001	NAD	C3N-C7N-N7N	2.17	120.41	117.74
2	B	1001	NAD	C4A-N9A-C8A	2.11	107.95	105.74
2	D	1001	NAD	N9A-C8A-N7A	-2.11	110.94	113.94
2	B	1001	NAD	C6A-C5A-N7A	2.07	136.08	132.09
2	A	1001	NAD	C2A-N1A-C6A	2.05	122.09	118.73
2	D	1001	NAD	C2A-N1A-C6A	2.05	122.09	118.73
2	F	1001	NAD	C6N-N1N-C2N	-2.01	120.16	121.88

There are no chirality outliers.

All (28) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	1001	NAD	C5D-O5D-PN-O2N
2	C	1001	NAD	C5D-O5D-PN-O2N
2	D	1001	NAD	C5D-O5D-PN-O3
2	E	1001	NAD	C5D-O5D-PN-O2N
2	F	1001	NAD	C5D-O5D-PN-O2N
2	C	1001	NAD	C2N-C3N-C7N-O7N
2	F	1001	NAD	C2N-C3N-C7N-O7N
2	C	1001	NAD	C2N-C3N-C7N-N7N
2	C	1001	NAD	C4N-C3N-C7N-O7N
2	C	1001	NAD	C4N-C3N-C7N-N7N
2	F	1001	NAD	C4N-C3N-C7N-O7N
2	F	1001	NAD	C4N-C3N-C7N-N7N
2	F	1001	NAD	C2N-C3N-C7N-N7N
2	B	1001	NAD	C5D-O5D-PN-O3
2	B	1001	NAD	C5D-O5D-PN-O1N

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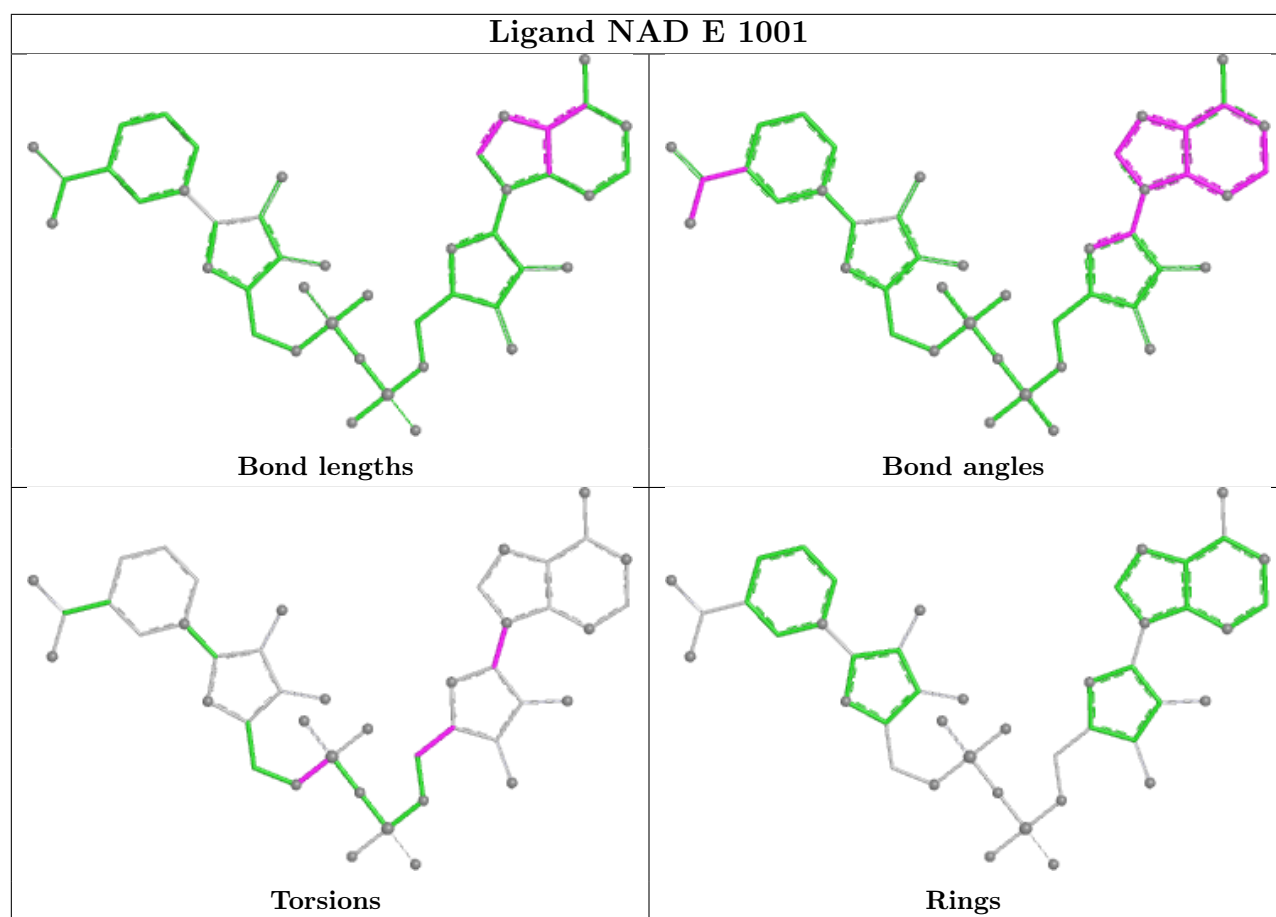
Mol	Chain	Res	Type	Atoms
2	C	1001	NAD	C5D-O5D-PN-O3
2	D	1001	NAD	C5D-O5D-PN-O1N
2	E	1001	NAD	C5D-O5D-PN-O3
2	F	1001	NAD	C5D-O5D-PN-O3
2	F	1001	NAD	C5D-O5D-PN-O1N
2	D	1001	NAD	C4N-C3N-C7N-N7N
2	D	1001	NAD	C4N-C3N-C7N-O7N
2	A	1001	NAD	O4D-C4D-C5D-O5D
2	E	1001	NAD	O4B-C4B-C5B-O5B
2	D	1001	NAD	C2B-C1B-N9A-C8A
2	E	1001	NAD	C2B-C1B-N9A-C8A
2	D	1001	NAD	C2N-C3N-C7N-N7N
2	A	1001	NAD	PN-O3-PA-O2A

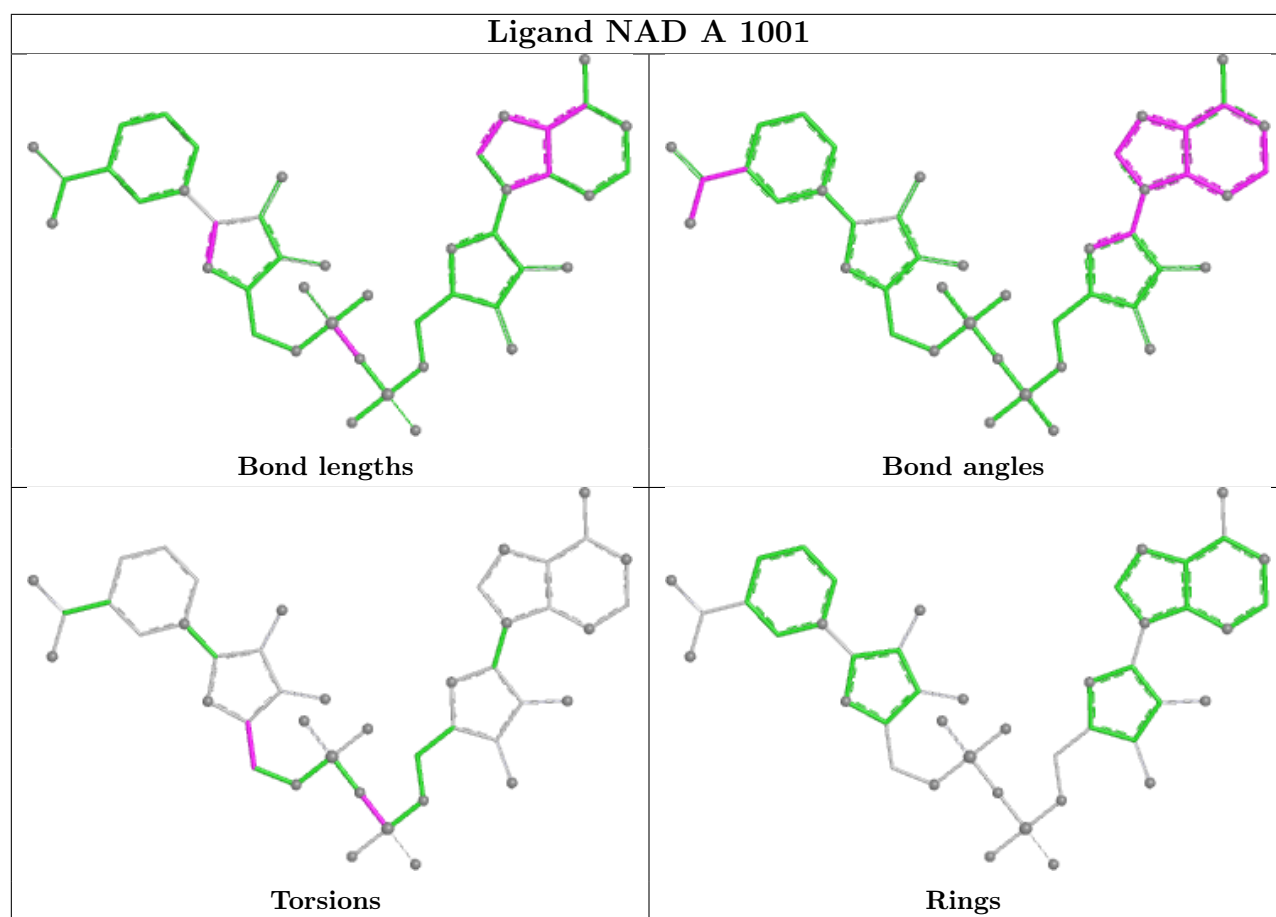
There are no ring outliers.

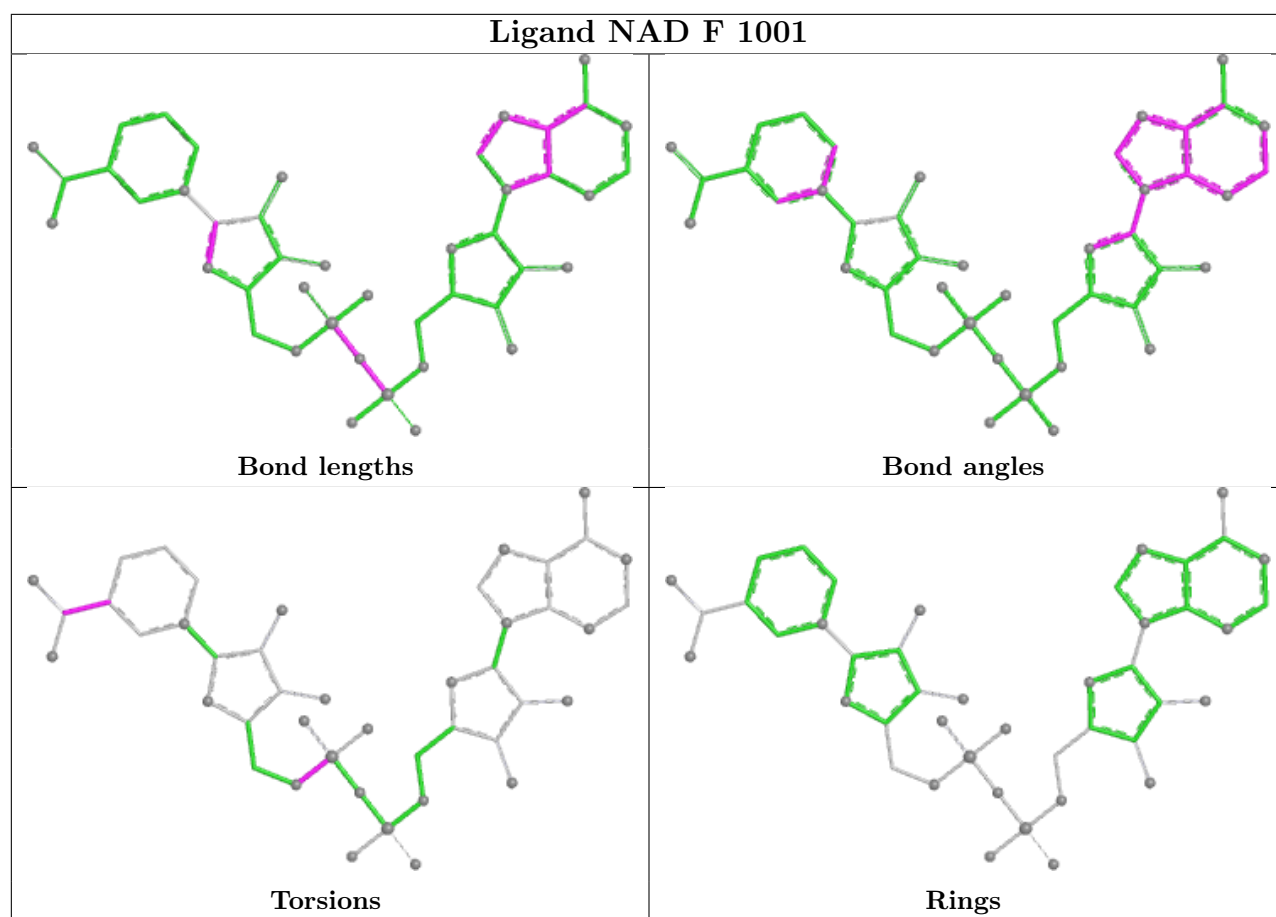
4 monomers are involved in 7 short contacts:

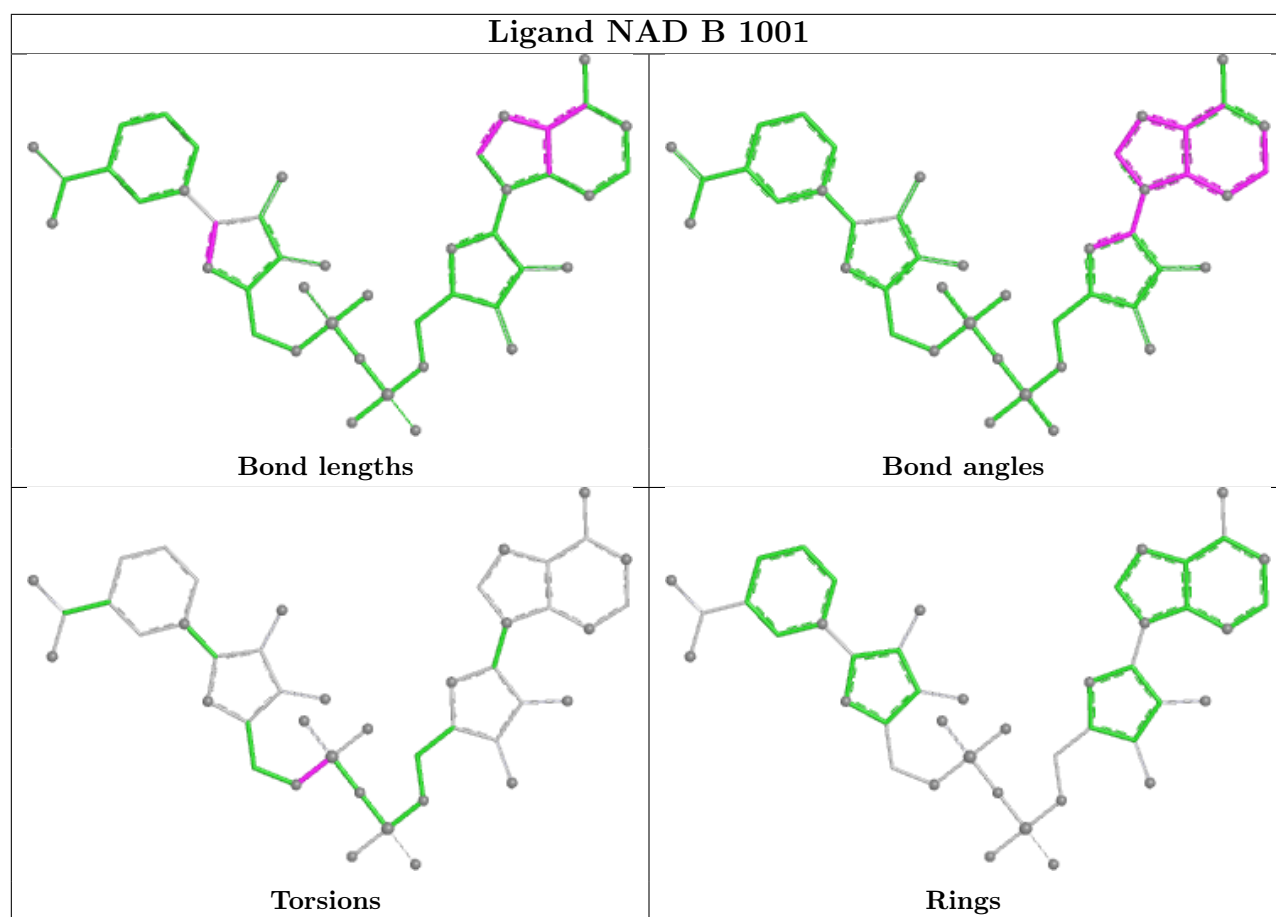
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1001	NAD	3	0
2	F	1001	NAD	1	0
2	B	1001	NAD	2	0
2	C	1001	NAD	1	0

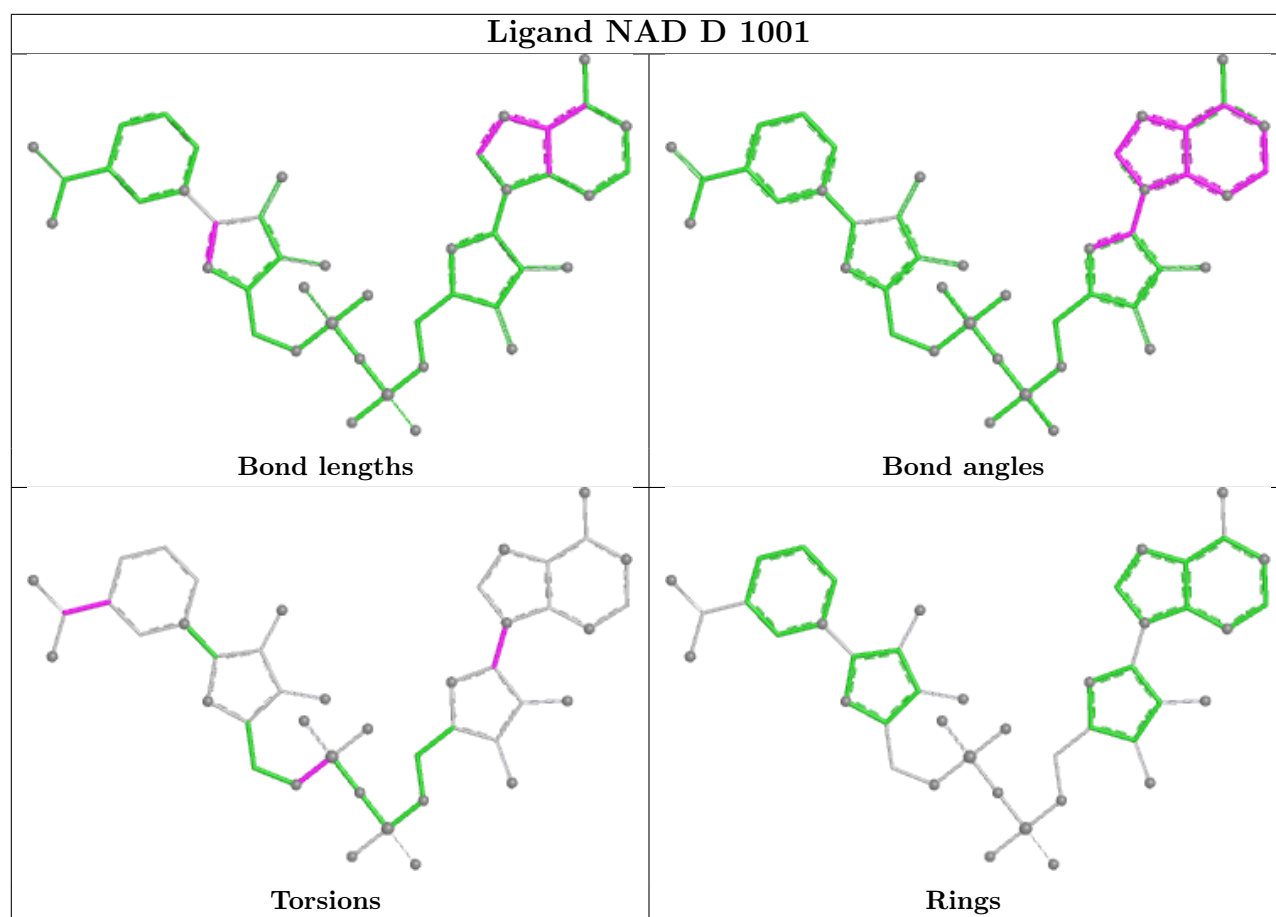
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included.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

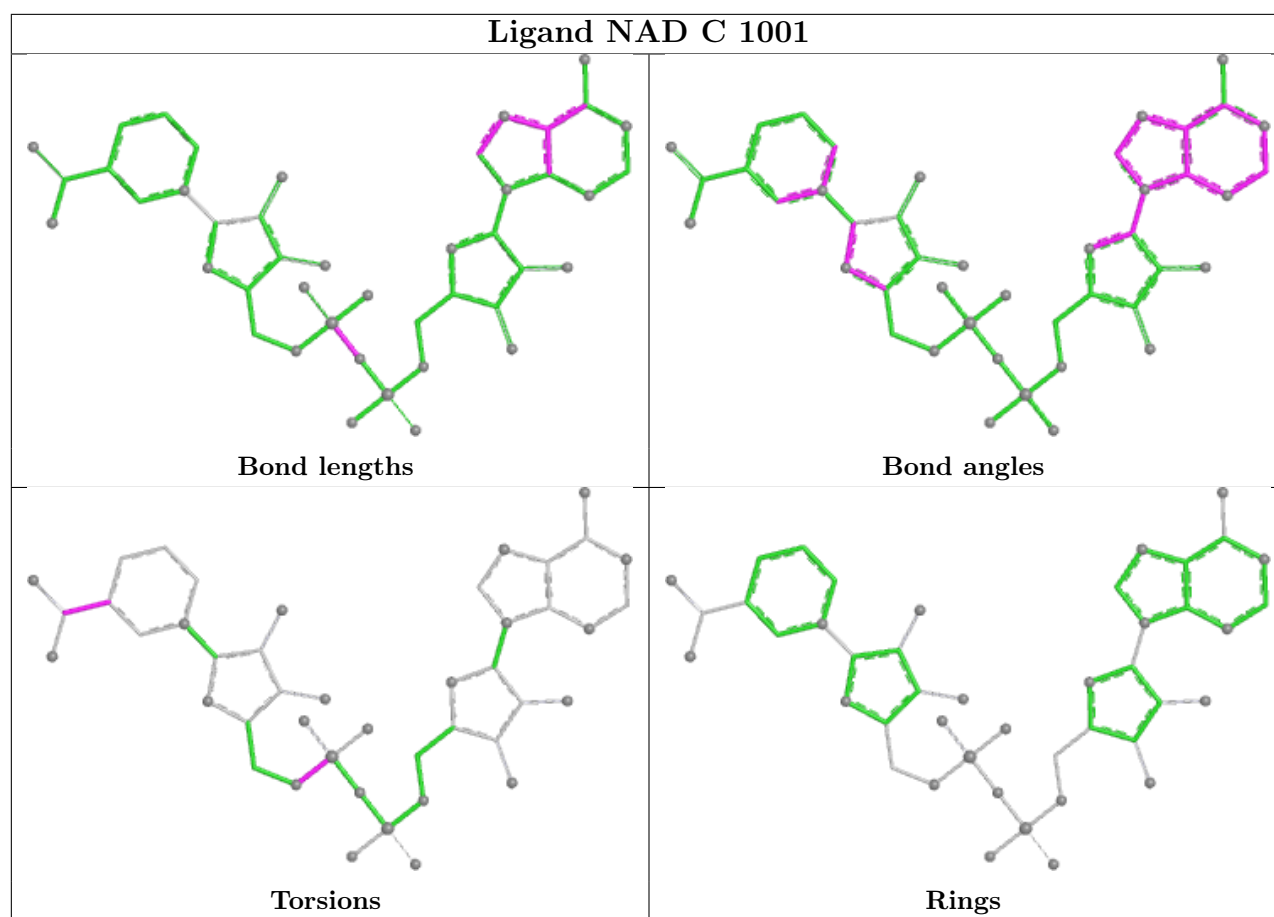












5.7 Other polymers [i](#)

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, 95th 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 ²)	Q < 0.9
1	A	206/329 (62%)	0.24	9 (4%)	39 25	55, 83, 118, 142	0
1	B	215/329 (65%)	-0.02	2 (0%)	81 65	51, 73, 105, 133	0
1	C	249/329 (75%)	0.15	11 (4%)	39 25	43, 69, 128, 148	0
1	D	232/329 (70%)	0.09	6 (2%)	57 38	47, 71, 125, 146	0
1	E	223/329 (67%)	0.07	8 (3%)	46 31	45, 69, 101, 140	0
1	F	208/329 (63%)	0.06	4 (1%)	66 48	46, 70, 128, 169	0
All	All	1333/1974 (67%)	0.10	40 (3%)	52 35	43, 72, 121, 169	0

All (40) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	263	LEU	5.0
1	A	133	SER	3.7
1	E	362	PHE	3.7
1	C	303	LEU	3.7
1	E	133	SER	3.5
1	B	55	PRO	3.4
1	D	359	MET	3.3
1	C	184	PRO	3.2
1	C	332	PRO	3.2
1	A	55	PRO	2.9
1	F	294	SER	2.9
1	E	338	SER	2.8
1	D	55	PRO	2.7
1	C	171	ILE	2.6
1	C	188	ILE	2.6
1	E	55	PRO	2.6
1	A	171	ILE	2.6
1	C	334	ILE	2.6
1	E	299	THR	2.6

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Mol	Chain	Res	Type	RSRZ
1	F	352	LEU	2.6
1	D	294	SER	2.4
1	D	300	PRO	2.3
1	D	308	ARG	2.3
1	C	260	GLY	2.3
1	C	301	GLU	2.3
1	C	333	MET	2.3
1	F	55	PRO	2.3
1	A	356	VAL	2.3
1	C	359	MET	2.2
1	A	352	LEU	2.2
1	E	303	LEU	2.2
1	A	355	LEU	2.2
1	C	172	GLY	2.1
1	F	191	PRO	2.1
1	D	293	ILE	2.1
1	A	293	ILE	2.1
1	B	228	ALA	2.1
1	E	340	ALA	2.1
1	A	226	ILE	2.0
1	A	290	THR	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 oligosaccharides 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, 95th 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($\text{\AA}^2$)	Q<0.9
2	NAD	A	1001	44/44	0.86	0.14	87,121,134,143	0
2	NAD	B	1001	44/44	0.91	0.12	72,100,110,118	0

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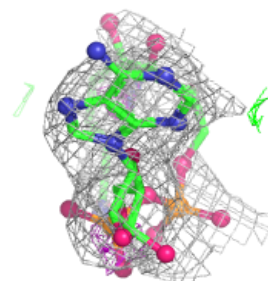
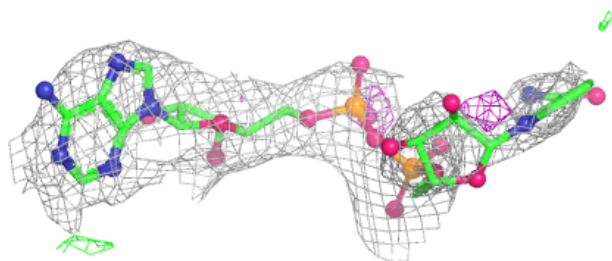
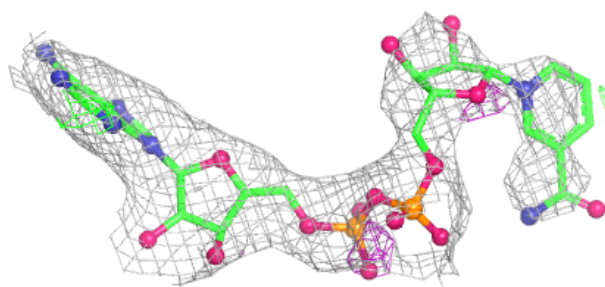
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	NAD	D	1001	44/44	0.92	0.11	66,95,107,109	0
2	NAD	F	1001	44/44	0.93	0.11	71,100,126,128	0
2	NAD	C	1001	44/44	0.94	0.10	64,77,98,108	0
2	NAD	E	1001	44/44	0.95	0.09	66,80,99,103	0

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.

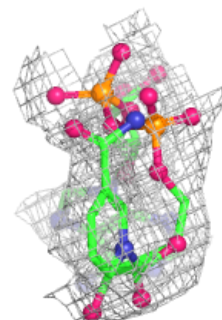
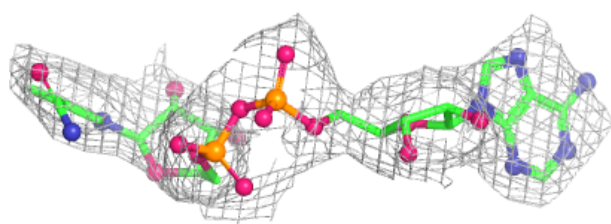
Electron density around NAD A 1001:

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

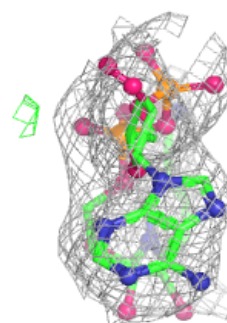
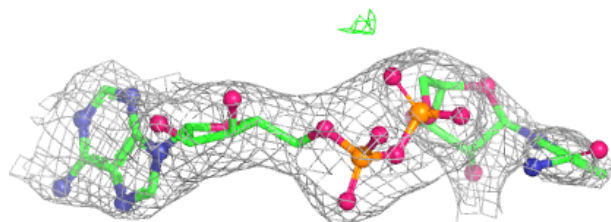
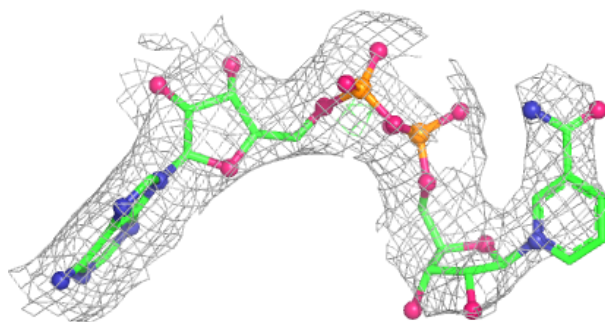


Electron density around NAD B 1001:

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

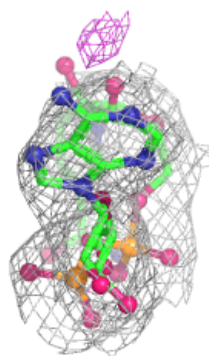
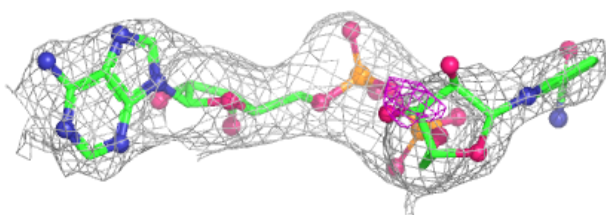
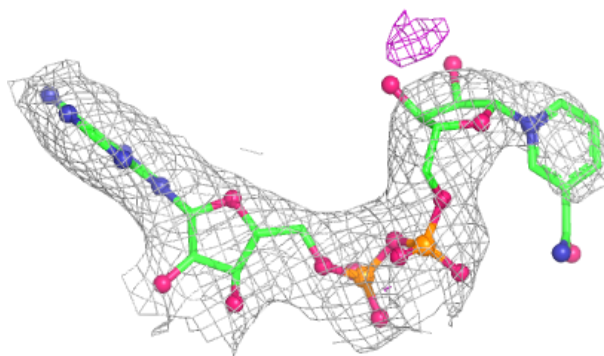
**Electron density around NAD D 1001:**

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

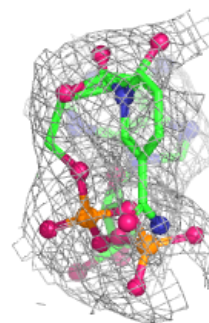
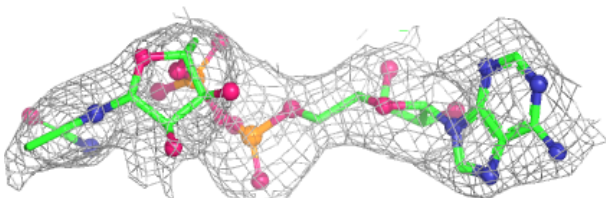
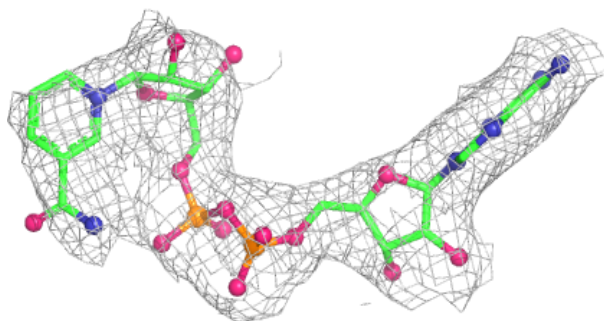


Electron density around NAD F 1001:

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

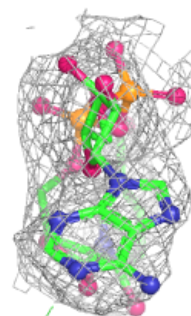
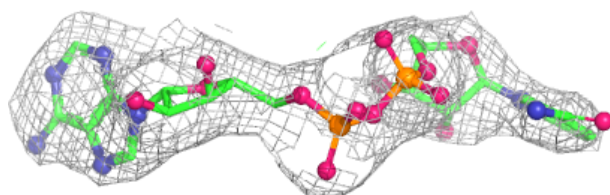
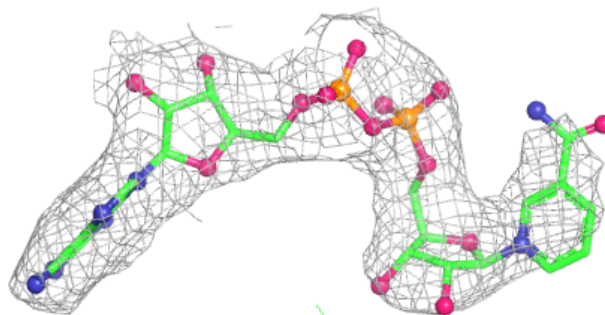
**Electron density around NAD C 1001:**

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



Electron density around NAD E 1001:

$2mF_o-DF_c$ (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.