Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 02:37 AM UTC

PDB ID	:	1U8F / pdb_00001u8f
Title	:	Crystal Structure Of Human Placental Glyceraldehyde-3-Phosphate Dehydrogenase At 1.75 Resolution
Authors	:	Jenkins, J.L.; Tanner, J.J.
Deposited on	:	2004-08-05
Resolution	:	1.75 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:

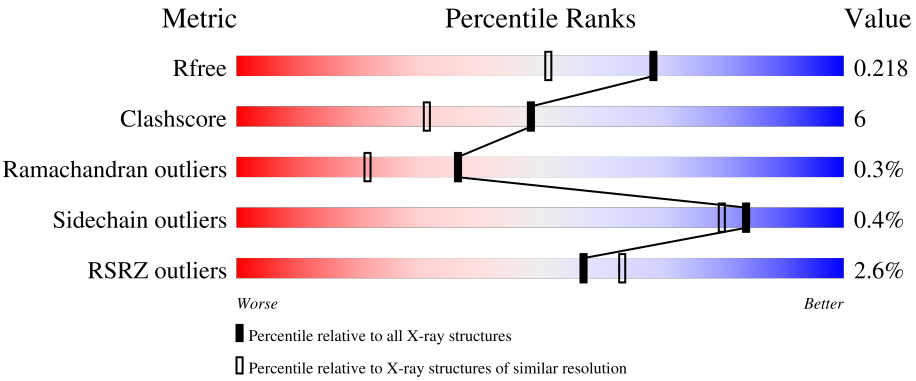
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal 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 1.75 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	3183 (1.76-1.76)
Clashscore	190562	3299 (1.76-1.76)
Ramachandran outliers	187476	3274 (1.76-1.76)
Sidechain outliers	187428	3274 (1.76-1.76)
RSRZ outliers	180081	3183 (1.76-1.76)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions <=5% 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	O	335	4% 84% 15% ••
1	P	335	% 83% 16% •
1	Q	335	3% 87% 12% ••
1	R	335	3% 88% 10% ••

2 Entry composition

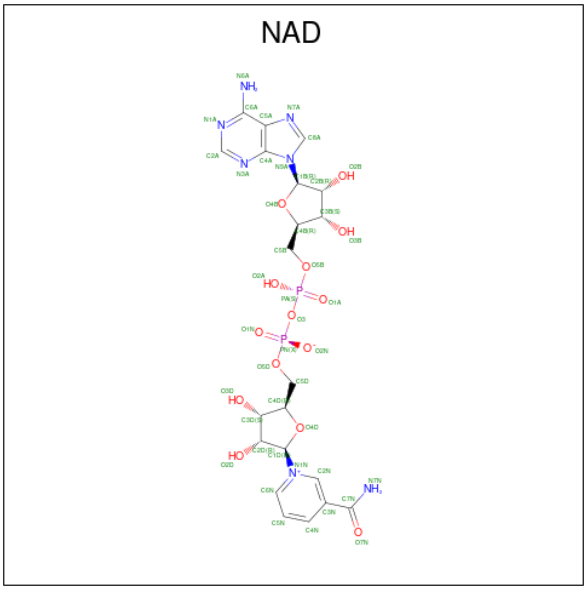
There are 3 unique types of molecules in this entry. The entry contains 11176 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Glyceraldehyde-3-phosphate dehydrogenase, liver.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	O	333	Total	C	N	O	S	3	2	0
			2538	1604	440	481	13			
1	P	333	Total	C	N	O	S	0	1	0
			2532	1601	439	480	12			
1	Q	333	Total	C	N	O	S	2	2	0
			2540	1606	440	481	13			
1	R	333	Total	C	N	O	S	0	0	0
			2523	1596	438	477	12			

- Molecule 2 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (CCD ID: NAD) (formula: $C_{21}H_{27}N_7O_{14}P_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	P	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
2	Q	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	R	1	Total	C	N	O	P	0	0
			44	21	7	14	2		

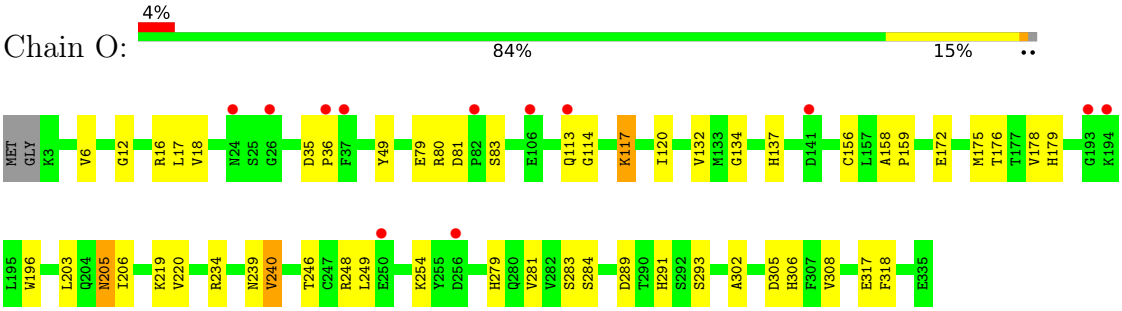
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	O	206	Total	O	0	0
			206	206		
3	P	241	Total	O	0	0
			241	241		
3	Q	231	Total	O	0	0
			231	231		
3	R	233	Total	O	0	0
			233	233		

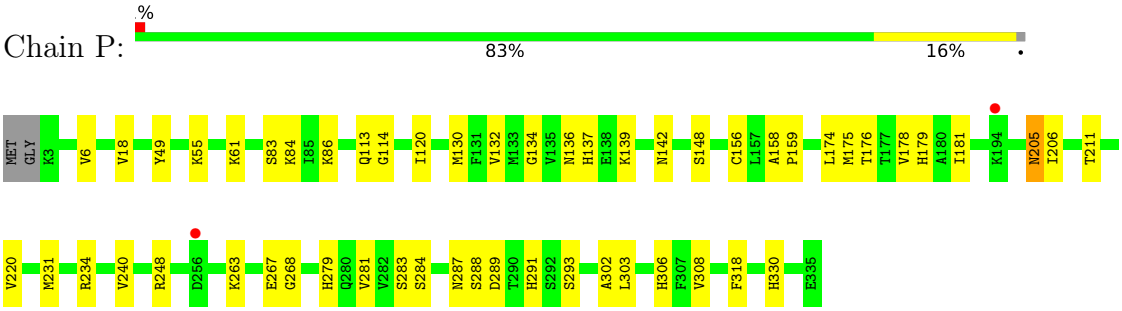
3 Residue-property plots (i)

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.

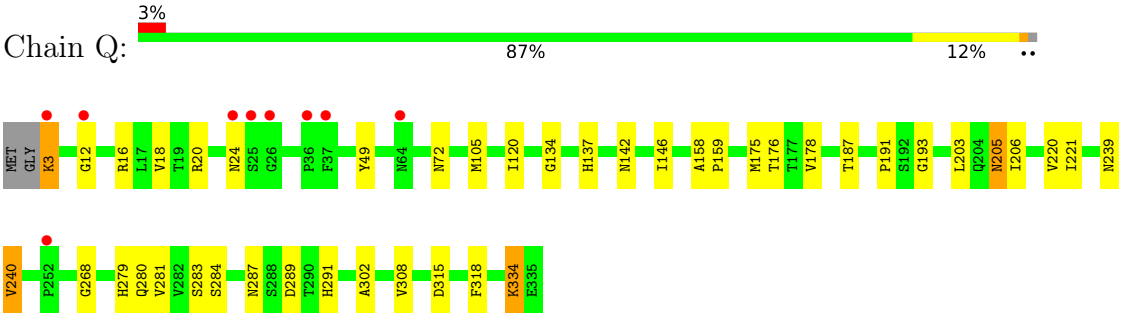
• Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase, liver



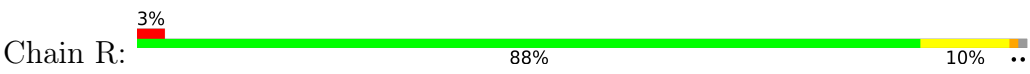
• Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase, liver

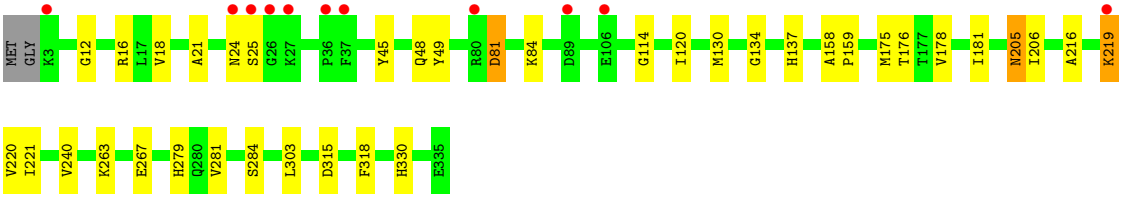


• Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase, liver



• Molecule 1: Glyceraldehyde-3-phosphate dehydrogenase, liver




MET
GLY
K3
G12
R16
L17
V18
A21
N24
S25
G26
K27
P36
F37
Y45
Q48
Y49
R80
D81
K84
D89
E106
G114
I120
M130
G134
H137
A158
P159
M175
T176
T177
V178
I181
N205
I206
A216
K219
V220
I221
V240
K263
E267
H279
Q280
V281
S284
L303
D315
F318
H330
E335

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	84.95Å 125.65Å 132.33Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 1.75 50.00 – 1.75	Depositor EDS
% Data completeness (in resolution range)	99.6 (50.00-1.75) 99.5 (50.00-1.75)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.95 (at 1.75Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.191 , 0.217 0.191 , 0.218	Depositor DCC
R_{free} test set	14147 reflections (9.98%)	wwPDB-VP
Wilson B-factor (Å^2)	13.8	Xtriage
Anisotropy	0.207	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.44 , 49.6	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.006 for -h,l,k	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	11176	wwPDB-VP
Average B, all atoms (Å^2)	16.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.70% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	O	0.35	1/2588 (0.0%)	0.93	14/3501 (0.4%)
1	P	0.33	0/2582	0.91	12/3493 (0.3%)
1	Q	0.34	0/2590	0.94	12/3503 (0.3%)
1	R	0.33	0/2573	0.94	10/3481 (0.3%)
All	All	0.34	1/10333 (0.0%)	0.93	48/13978 (0.3%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	O	219	LYS	CG-CD	7.35	1.74	1.52

All (48) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	Q	206	ILE	N-CA-C	-9.73	93.78	107.99
1	R	206	ILE	N-CA-C	-9.66	93.89	107.99
1	P	206	ILE	N-CA-C	-9.53	94.08	107.99
1	O	206	ILE	N-CA-C	-9.24	94.50	107.99
1	R	205	ASN	N-CA-C	8.76	123.69	109.85
1	P	205	ASN	N-CA-C	8.50	123.28	109.85
1	Q	205	ASN	N-CA-C	8.48	123.25	109.85
1	O	205	ASN	N-CA-C	8.26	122.90	109.85
1	R	281	VAL	N-CA-C	7.03	117.71	110.05
1	O	281	VAL	N-CA-C	6.94	117.61	110.05
1	Q	281	VAL	N-CA-C	6.86	117.53	110.05
1	P	178	VAL	N-CA-C	-6.38	98.00	107.51
1	Q	178	VAL	N-CA-C	-6.38	98.01	107.51
1	R	178	VAL	N-CA-C	-6.18	98.08	107.73
1	O	219	LYS	CB-CG-CD	-6.14	97.17	111.30
1	P	281	VAL	N-CA-C	6.08	116.68	110.05

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	O	283	SER	N-CA-C	6.07	118.39	111.11
1	Q	18	VAL	N-CA-C	-6.04	104.62	110.72
1	O	178	VAL	N-CA-C	-5.97	98.41	107.73
1	Q	193	GLY	N-CA-C	5.77	119.87	112.83
1	O	196	TRP	N-CA-C	5.70	118.23	111.33
1	O	318	PHE	N-CA-C	5.60	117.47	111.36
1	P	268	GLY	CA-C-N	5.60	125.27	119.56
1	P	268	GLY	C-N-CA	5.60	125.27	119.56
1	R	81	ASP	CA-C-N	5.55	125.65	119.32
1	R	81	ASP	C-N-CA	5.55	125.65	119.32
1	O	35	ASP	CA-C-N	5.52	125.13	119.56
1	O	35	ASP	C-N-CA	5.52	125.13	119.56
1	P	303	LEU	N-CA-C	-5.51	104.79	112.45
1	P	142	ASN	N-CA-C	5.50	119.49	112.34
1	P	318	PHE	N-CA-C	5.47	117.05	111.14
1	P	6	VAL	N-CA-C	5.41	117.18	108.85
1	R	303	LEU	N-CA-C	-5.40	104.94	112.45
1	Q	318	PHE	N-CA-C	5.39	117.24	111.36
1	P	18	VAL	N-CA-C	-5.38	105.28	110.72
1	P	283	SER	N-CA-C	5.32	117.49	111.11
1	O	18	VAL	N-CA-C	-5.30	105.36	110.72
1	Q	315	ASP	N-CA-C	-5.24	99.22	108.23
1	O	81	ASP	CA-C-N	5.23	125.29	119.32
1	O	81	ASP	C-N-CA	5.23	125.29	119.32
1	Q	268	GLY	CA-C-N	5.23	125.03	119.28
1	Q	268	GLY	C-N-CA	5.23	125.03	119.28
1	O	6	VAL	N-CA-C	5.14	116.77	108.85
1	R	18	VAL	N-CA-C	-5.10	105.57	110.72
1	R	315	ASP	N-CA-C	-5.09	99.48	108.23
1	R	318	PHE	N-CA-C	5.09	116.90	111.36
1	Q	283	SER	N-CA-C	5.05	117.44	111.33
1	Q	142	ASN	N-CA-C	5.01	118.89	112.87

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	O	2538	0	2533	34	0
1	P	2532	0	2529	36	0
1	Q	2540	0	2537	36	0
1	R	2523	0	2524	30	0
2	P	44	0	26	0	0
2	Q	44	0	26	1	0
2	R	44	0	26	1	0
3	O	206	0	0	2	0
3	P	241	0	0	4	0
3	Q	231	0	0	3	0
3	R	233	0	0	4	0
All	All	11176	0	10201	113	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 6.

All (113) 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:P:84:LYS:HA	1:P:84:LYS:HE2	1.56	0.86
1:R:134:GLY:H	1:R:137:HIS:HD2	1.28	0.81
1:R:134:GLY:H	1:R:137:HIS:CD2	1.99	0.80
1:O:134:GLY:H	1:O:137:HIS:CD2	2.00	0.78
1:Q:134:GLY:H	1:Q:137:HIS:HD2	1.29	0.78
1:P:134:GLY:H	1:P:137:HIS:CD2	2.02	0.77
1:Q:134:GLY:H	1:Q:137:HIS:CD2	2.02	0.77
1:O:134:GLY:H	1:O:137:HIS:HD2	1.34	0.74
1:P:181:ILE:HD13	1:Q:203:LEU:HD22	1.73	0.69
1:P:134:GLY:H	1:P:137:HIS:HD2	1.43	0.66
1:P:49:TYR:HE1	1:P:55:LYS:HE2	1.62	0.65
1:O:203:LEU:HD22	1:R:181:ILE:HD13	1.79	0.64
1:P:49:TYR:OH	1:R:279:HIS:HD2	1.79	0.64
1:O:49:TYR:OH	1:Q:279:HIS:HD2	1.81	0.64
1:O:205:ASN:HD22	1:P:284:SER:H	1.46	0.64
1:O:117:LYS:HE3	1:O:117:LYS:HA	1.81	0.62
1:R:25:SER:HB3	3:R:524:HOH:O	2.01	0.61
1:Q:205:ASN:HD21	1:R:284:SER:CB	2.14	0.61
1:O:175:MET:HG2	1:O:176:THR:N	2.16	0.60
1:O:279:HIS:HD2	1:Q:49:TYR:OH	1.85	0.60
1:Q:205:ASN:HD21	1:R:284:SER:HB2	1.66	0.60
1:O:284:SER:H	1:P:205:ASN:HD22	1.49	0.60
1:Q:284:SER:H	1:R:205:ASN:HD22	1.48	0.60

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:Q:334:LYS:NZ	1:Q:334:LYS:HB3	2.17	0.59
1:O:302:ALA:CB	1:O:308:VAL:HG12	2.33	0.58
1:P:279:HIS:HD2	1:R:49:TYR:OH	1.87	0.57
1:P:175:MET:HG2	1:P:176:THR:N	2.18	0.57
1:Q:284:SER:H	1:R:205:ASN:ND2	2.02	0.57
1:O:205:ASN:ND2	1:P:284:SER:H	2.02	0.57
1:Q:334:LYS:HE3	3:Q:428:HOH:O	2.05	0.57
1:O:158:ALA:HB3	1:O:159:PRO:HD3	1.87	0.57
1:Q:280:GLN:NE2	3:Q:378:HOH:O	2.38	0.56
1:Q:205:ASN:HD22	1:R:284:SER:H	1.53	0.56
1:R:45:TYR:HA	1:R:48:GLN:HE21	1.70	0.56
1:O:284:SER:H	1:P:205:ASN:ND2	2.05	0.55
1:Q:302:ALA:CB	1:Q:308:VAL:HG12	2.36	0.55
1:R:175:MET:HG2	1:R:176:THR:N	2.21	0.55
1:O:205:ASN:HD21	1:P:284:SER:CB	2.20	0.55
1:P:61:LYS:HE2	3:P:558:HOH:O	2.07	0.55
1:Q:284:SER:CB	1:R:205:ASN:HD21	2.20	0.54
1:Q:205:ASN:ND2	1:R:284:SER:H	2.05	0.54
1:R:81:ASP:OD2	1:R:84:LYS:HG2	2.08	0.54
1:Q:284:SER:HB2	1:R:205:ASN:HD21	1.72	0.53
1:P:158:ALA:HB3	1:P:159:PRO:HD3	1.90	0.53
1:R:158:ALA:HB3	1:R:159:PRO:HD3	1.90	0.53
1:Q:12:GLY:HA3	2:Q:336:NAD:O5B	2.10	0.52
1:O:172:GLU:OE2	1:O:248:ARG:HD3	2.11	0.51
1:R:12:GLY:HA3	2:R:336:NAD:O5B	2.11	0.51
1:O:36:PRO:HG3	1:O:79:GLU:C	2.36	0.50
1:P:49:TYR:CE1	1:P:55:LYS:HE2	2.45	0.50
1:O:120:ILE:HD12	1:O:120:ILE:N	2.26	0.50
1:O:254:LYS:HD3	1:O:305:ASP:OD1	2.12	0.50
1:O:284:SER:CB	1:P:205:ASN:HD21	2.24	0.50
1:P:181:ILE:CD1	1:Q:203:LEU:HD22	2.41	0.50
1:Q:175:MET:HG2	1:Q:176:THR:N	2.26	0.49
1:P:83:SER:HB2	1:P:113:GLN:NE2	2.27	0.48
1:O:36:PRO:HG3	1:O:79:GLU:O	2.13	0.47
1:R:48:GLN:HG3	1:R:49:TYR:CD2	2.49	0.47
1:P:263:LYS:O	1:P:267:GLU:HG3	2.13	0.47
1:P:302:ALA:CB	1:P:308:VAL:HG12	2.43	0.47
1:P:156:CYS:HA	1:P:293:SER:HB2	1.96	0.47
1:Q:158:ALA:HB3	1:Q:159:PRO:HD3	1.97	0.47
1:O:179:HIS:HB3	1:O:234:ARG:HD3	1.97	0.46
1:Q:72:ASN:HD22	1:Q:72:ASN:N	2.13	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:R:263:LYS:O	1:R:267:GLU:HG3	2.16	0.46
1:O:80:ARG:HG3	1:O:80:ARG:HH11	1.81	0.45
1:R:130:MET:HE2	1:R:219:LYS:HZ3	1.79	0.45
1:R:21:ALA:HA	1:R:24:ASN:OD1	2.16	0.45
1:P:289:ASP:OD1	1:P:291:HIS:HD2	2.00	0.45
1:P:330:HIS:HD2	3:P:565:HOH:O	1.98	0.45
1:R:120:ILE:HD12	1:R:120:ILE:N	2.31	0.45
1:R:130:MET:HE1	1:R:216:ALA:HB1	1.98	0.45
1:O:83:SER:HB2	1:O:113:GLN:NE2	2.32	0.45
1:P:179:HIS:HB3	1:P:234:ARG:HD3	1.97	0.45
1:R:12:GLY:O	1:R:16:ARG:HG3	2.17	0.45
1:Q:120:ILE:HD12	1:Q:120:ILE:N	2.32	0.44
1:O:132:VAL:HG23	1:O:220:VAL:HG11	2.00	0.44
1:Q:12:GLY:O	1:Q:16:ARG:HG3	2.18	0.44
1:O:302:ALA:HB1	1:O:308:VAL:HG12	1.99	0.43
1:P:181:ILE:HD12	1:Q:187:THR:HB	2.01	0.43
1:Q:240:VAL:HG21	1:Q:287:ASN:HD22	1.83	0.43
1:O:156:CYS:HA	1:O:293:SER:HB2	2.01	0.43
1:O:246:THR:HG23	1:P:174:LEU:HD12	2.00	0.43
1:O:291:HIS:HE1	3:O:368:HOH:O	2.01	0.43
1:P:287:ASN:O	1:P:288:SER:HB2	2.18	0.43
1:Q:302:ALA:HB1	1:Q:308:VAL:HG12	1.99	0.43
1:O:289:ASP:OD1	1:O:291:HIS:HD2	2.02	0.43
1:P:86:LYS:N	1:P:86:LYS:HD2	2.33	0.43
1:P:211:THR:HG22	1:P:231:MET:HA	2.01	0.43
1:O:12:GLY:O	1:O:16:ARG:HG3	2.19	0.43
1:R:114:GLY:HA3	3:R:529:HOH:O	2.19	0.43
1:R:137:HIS:HE1	3:R:465:HOH:O	2.02	0.43
1:P:248:ARG:HA	1:P:306:HIS:O	2.19	0.42
1:Q:289:ASP:OD1	1:Q:291:HIS:HD2	2.02	0.42
1:Q:24:ASN:N	1:Q:24:ASN:HD22	2.17	0.42
1:R:330:HIS:HE1	3:R:400:HOH:O	2.01	0.42
1:Q:334:LYS:HB3	1:Q:334:LYS:HZ2	1.84	0.42
1:P:114:GLY:HA3	3:P:374:HOH:O	2.19	0.42
1:Q:3:LYS:NZ	1:Q:3:LYS:HB3	2.34	0.42
1:P:132:VAL:HG23	1:P:220:VAL:HG11	2.02	0.42
1:P:120:ILE:N	1:P:120:ILE:HD12	2.35	0.41
1:Q:105[A]:MET:SD	1:Q:146:ILE:HB	2.61	0.41
1:Q:239:ASN:O	1:Q:240:VAL:HB	2.21	0.41
1:O:17:LEU:CD1	1:O:317:GLU:HB3	2.50	0.41
1:Q:20:ARG:HD3	3:Q:479:HOH:O	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:Q:220:VAL:HG23	1:Q:221:ILE:HG13	2.02	0.41
1:O:239:ASN:O	1:O:240:VAL:HB	2.20	0.41
1:O:249:LEU:O	1:O:306:HIS:HD2	2.04	0.41
1:P:136:ASN:O	1:P:139:LYS:HB2	2.21	0.41
3:P:453:HOH:O	1:Q:191:PRO:HD3	2.20	0.41
1:O:114:GLY:HA3	3:O:485:HOH:O	2.21	0.40
1:P:130:MET:HG2	1:P:148:SER:HB3	2.04	0.40
1:R:220:VAL:HG23	1:R:221:ILE:HG13	2.03	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	O	333/335 (99%)	318 (96%)	14 (4%)	1 (0%)	36	21
1	P	332/335 (99%)	316 (95%)	15 (4%)	1 (0%)	36	21
1	Q	333/335 (99%)	319 (96%)	13 (4%)	1 (0%)	36	21
1	R	331/335 (99%)	314 (95%)	16 (5%)	1 (0%)	36	21
All	All	1329/1340 (99%)	1267 (95%)	58 (4%)	4 (0%)	36	21

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	O	240	VAL
1	Q	240	VAL
1	P	240	VAL
1	R	240	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	O	272/271 (100%)	271 (100%)	1 (0%)	84 80
1	P	271/271 (100%)	271 (100%)	0	100 100
1	Q	272/271 (100%)	270 (99%)	2 (1%)	76 67
1	R	270/271 (100%)	269 (100%)	1 (0%)	84 80
All	All	1085/1084 (100%)	1081 (100%)	4 (0%)	84 80

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

Mol	Chain	Res	Type
1	O	117	LYS
1	Q	3	LYS
1	Q	334	LYS
1	R	219	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (45) such sidechains are listed below:

Mol	Chain	Res	Type
1	O	64	ASN
1	O	78	GLN
1	O	113	GLN
1	O	137	HIS
1	O	205	ASN
1	O	225	ASN
1	O	264	GLN
1	O	279	HIS
1	O	287	ASN
1	O	291	HIS
1	O	306	HIS
1	O	322	ASN
1	O	330	HIS
1	P	24	ASN
1	P	48	GLN

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Mol	Chain	Res	Type
1	P	72	ASN
1	P	113	GLN
1	P	137	HIS
1	P	205	ASN
1	P	264	GLN
1	P	279	HIS
1	P	280	GLN
1	P	291	HIS
1	P	306	HIS
1	P	330	HIS
1	Q	24	ASN
1	Q	72	ASN
1	Q	113	GLN
1	Q	137	HIS
1	Q	205	ASN
1	Q	264	GLN
1	Q	279	HIS
1	Q	280	GLN
1	Q	287	ASN
1	Q	291	HIS
1	Q	330	HIS
1	R	48	GLN
1	R	72	ASN
1	R	137	HIS
1	R	205	ASN
1	R	264	GLN
1	R	279	HIS
1	R	291	HIS
1	R	306	HIS
1	R	330	HIS

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

3 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\| > 2$	Counts	RMSZ	$\#\|Z\| > 2$
2	NAD	R	336	-	46,48,48	1.73	5 (10%)	64,73,73	1.88	11 (17%)
2	NAD	Q	336	-	46,48,48	1.72	5 (10%)	64,73,73	1.82	12 (18%)
2	NAD	P	336	-	46,48,48	1.63	6 (13%)	64,73,73	1.87	14 (21%)

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	R	336	-	-	4/30/62/62	0/5/5/5
2	NAD	Q	336	-	-	4/30/62/62	0/5/5/5
2	NAD	P	336	-	-	5/30/62/62	0/5/5/5

All (16) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	R	336	NAD	C2N-N1N	8.41	1.44	1.35
2	Q	336	NAD	C2N-N1N	8.21	1.44	1.35
2	P	336	NAD	C2N-N1N	7.72	1.43	1.35
2	Q	336	NAD	O4D-C1D	3.60	1.45	1.40
2	R	336	NAD	O4D-C1D	3.57	1.45	1.40
2	P	336	NAD	O4D-C1D	3.50	1.45	1.40
2	R	336	NAD	C5A-N7A	-3.44	1.32	1.39
2	P	336	NAD	C5A-N7A	-3.34	1.33	1.39

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	Q	336	NAD	C5A-N7A	-3.17	1.33	1.39
2	Q	336	NAD	C6N-N1N	3.04	1.42	1.35
2	P	336	NAD	C6N-N1N	3.00	1.42	1.35
2	R	336	NAD	C6N-N1N	2.94	1.42	1.35
2	Q	336	NAD	C3N-C7N	2.92	1.54	1.50
2	R	336	NAD	C3N-C7N	2.91	1.54	1.50
2	P	336	NAD	C3N-C7N	2.70	1.54	1.50
2	P	336	NAD	C4A-N9A	-2.01	1.33	1.37

All (37) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	P	336	NAD	N3A-C2A-N1A	-6.19	119.21	128.58
2	Q	336	NAD	N3A-C2A-N1A	-6.06	119.40	128.58
2	R	336	NAD	N3A-C2A-N1A	-6.02	119.47	128.58
2	R	336	NAD	C5A-C4A-N3A	-6.01	118.44	126.72
2	R	336	NAD	N3A-C4A-N9A	5.87	137.14	127.17
2	Q	336	NAD	C5A-C4A-N3A	-5.69	118.88	126.72
2	P	336	NAD	C5A-C4A-N3A	-5.62	118.97	126.72
2	P	336	NAD	N3A-C4A-N9A	5.54	136.59	127.17
2	Q	336	NAD	N3A-C4A-N9A	5.47	136.48	127.17
2	R	336	NAD	C2A-N3A-C4A	4.02	121.64	111.83
2	P	336	NAD	C2A-N3A-C4A	3.88	121.30	111.83
2	Q	336	NAD	C2A-N3A-C4A	3.86	121.26	111.83
2	R	336	NAD	C6A-C5A-N7A	-3.01	126.29	132.09
2	Q	336	NAD	C2A-N1A-C6A	2.92	123.52	118.73
2	P	336	NAD	C6N-N1N-C1D	-2.91	114.02	119.73
2	P	336	NAD	C2A-N1A-C6A	2.88	123.46	118.73
2	P	336	NAD	C6A-C5A-N7A	-2.85	126.60	132.09
2	R	336	NAD	C6N-N1N-C1D	-2.84	114.16	119.73
2	Q	336	NAD	C6A-C5A-N7A	-2.80	126.69	132.09
2	R	336	NAD	C6A-C5A-C4A	2.75	120.93	117.18
2	P	336	NAD	C2N-N1N-C1D	2.71	125.11	119.13
2	Q	336	NAD	C6A-C5A-C4A	2.69	120.85	117.18
2	Q	336	NAD	C6N-N1N-C1D	-2.68	114.46	119.73
2	R	336	NAD	C5N-C4N-C3N	2.68	123.00	120.36
2	Q	336	NAD	C5N-C4N-C3N	2.66	122.98	120.36
2	R	336	NAD	C2N-N1N-C1D	2.64	124.97	119.13
2	P	336	NAD	C5N-C4N-C3N	2.62	122.94	120.36
2	R	336	NAD	C2A-N1A-C6A	2.61	123.02	118.73
2	P	336	NAD	C6A-C5A-C4A	2.60	120.73	117.18
2	Q	336	NAD	C2N-N1N-C1D	2.51	124.68	119.13

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	P	336	NAD	C4A-N9A-C1B	-2.51	120.76	126.63
2	Q	336	NAD	C4A-N9A-C1B	-2.35	121.14	126.63
2	P	336	NAD	C4A-N9A-C8A	2.30	108.15	105.74
2	P	336	NAD	C2D-C3D-C4D	2.22	106.90	102.61
2	Q	336	NAD	C4A-N9A-C8A	2.18	108.03	105.74
2	P	336	NAD	O2N-PN-O1N	2.00	121.76	112.44
2	R	336	NAD	C4A-N9A-C8A	2.00	107.84	105.74

There are no chirality outliers.

All (13) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	P	336	NAD	O4D-C1D-N1N-C2N
2	P	336	NAD	O4D-C1D-N1N-C6N
2	P	336	NAD	C2D-C1D-N1N-C2N
2	P	336	NAD	C2D-C1D-N1N-C6N
2	Q	336	NAD	O4D-C1D-N1N-C2N
2	Q	336	NAD	O4D-C1D-N1N-C6N
2	Q	336	NAD	C2D-C1D-N1N-C6N
2	R	336	NAD	O4D-C1D-N1N-C2N
2	R	336	NAD	O4D-C1D-N1N-C6N
2	R	336	NAD	C2D-C1D-N1N-C6N
2	Q	336	NAD	C2D-C1D-N1N-C2N
2	R	336	NAD	C2D-C1D-N1N-C2N
2	P	336	NAD	PA-O3-PN-O1N

There are no ring outliers.

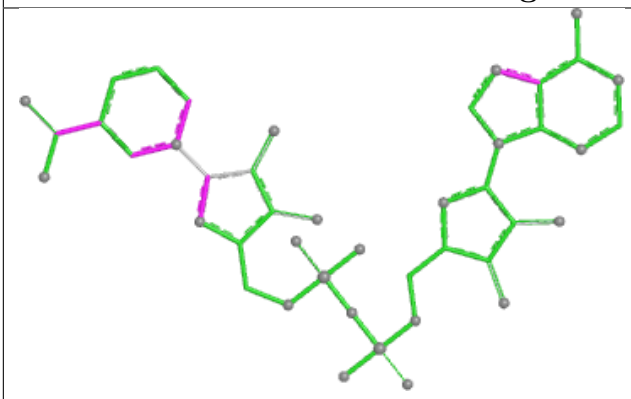
2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	R	336	NAD	1	0
2	Q	336	NAD	1	0

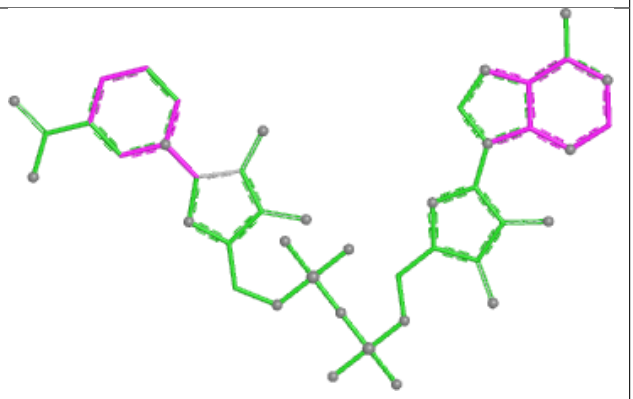
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and

any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

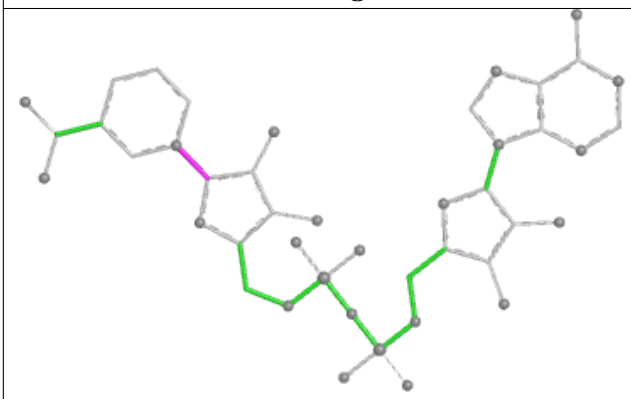
Ligand NAD R 336



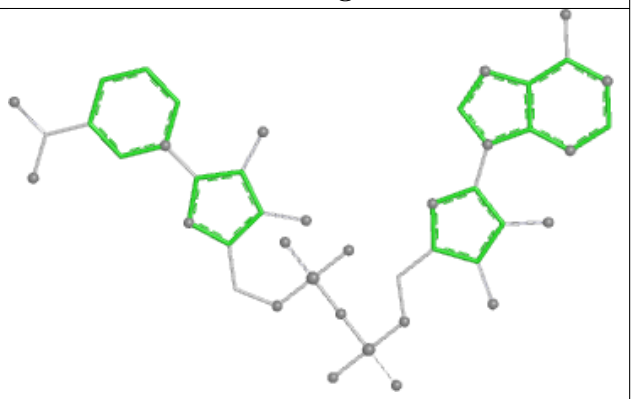
Bond lengths



Bond angles

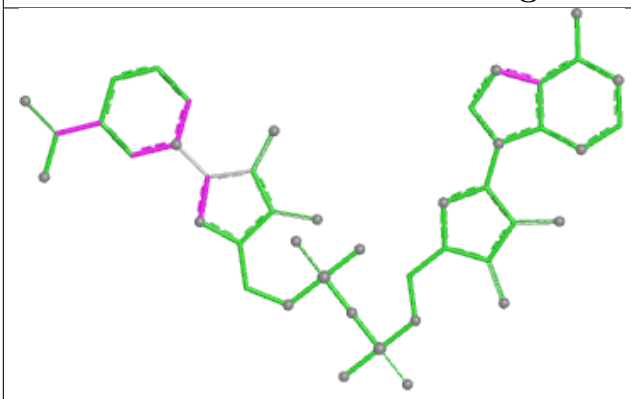


Torsions

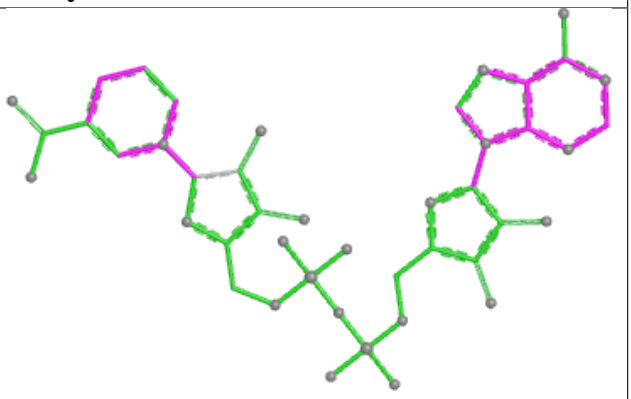


Rings

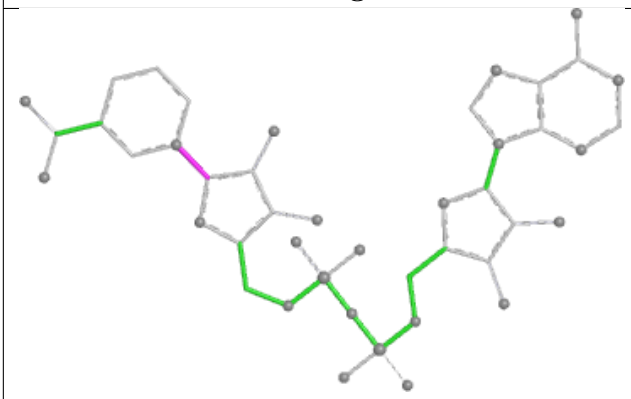
Ligand NAD Q 336



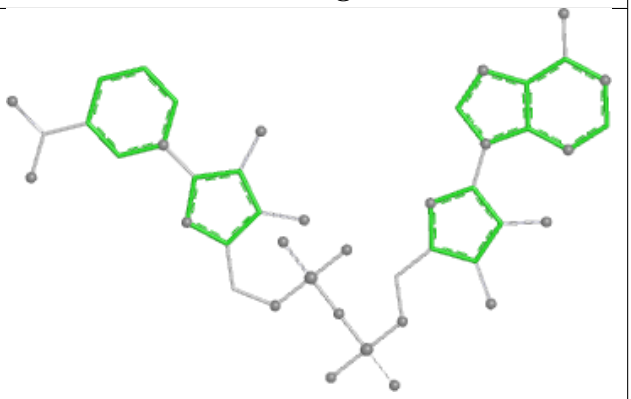
Bond lengths



Bond angles

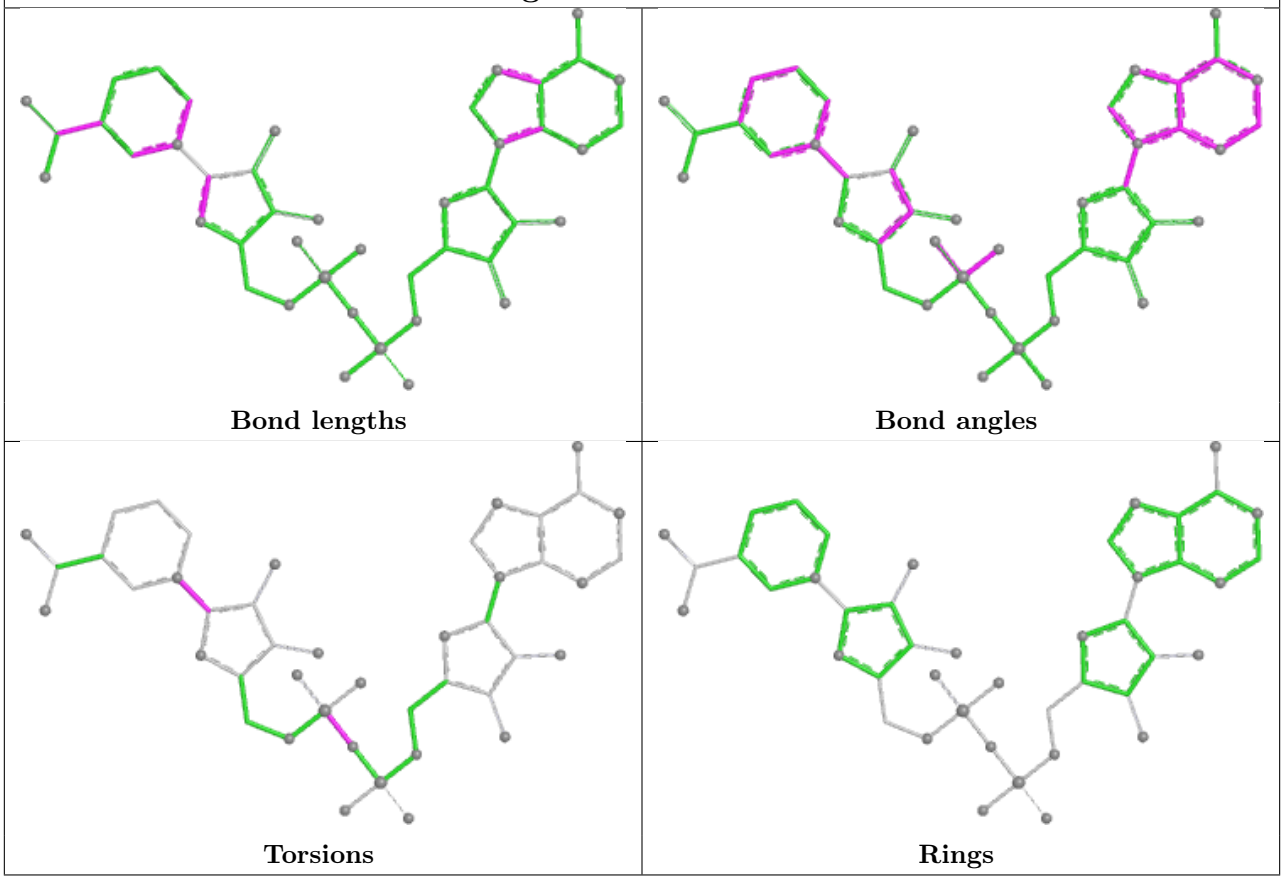


Torsions



Rings

Ligand NAD P 336



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^{th} 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	O	333/335 (99%)	0.23	12 (3%) 46 52	7, 15, 29, 38	3 (0%)
1	P	333/335 (99%)	0.02	2 (0%) 85 89	6, 14, 25, 33	1 (0%)
1	Q	333/335 (99%)	0.03	9 (2%) 56 62	6, 12, 25, 34	3 (0%)
1	R	333/335 (99%)	0.15	11 (3%) 49 55	6, 13, 28, 43	0
All	All	1332/1340 (99%)	0.11	34 (2%) 57 63	6, 14, 27, 43	7 (0%)

All (34) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	R	26	GLY	6.8
1	R	24	ASN	5.3
1	R	25	SER	5.0
1	Q	3	LYS	4.1
1	Q	25	SER	4.0
1	Q	26	GLY	3.8
1	Q	37	PHE	3.7
1	R	36	PRO	3.6
1	Q	24	ASN	3.6
1	O	37	PHE	3.5
1	O	194	LYS	3.2
1	R	3	LYS	3.1
1	R	37	PHE	3.1
1	O	36	PRO	3.0
1	O	26	GLY	2.9
1	R	27	LYS	2.9
1	R	89	ASP	2.8
1	Q	64	ASN	2.6
1	Q	36	PRO	2.6
1	Q	252	PRO	2.6
1	O	193	GLY	2.6

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Mol	Chain	Res	Type	RSRZ
1	R	106	GLU	2.6
1	R	219	LYS	2.5
1	Q	12	GLY	2.5
1	O	141	ASP	2.4
1	R	80	ARG	2.4
1	O	113	GLN	2.3
1	O	250	GLU	2.3
1	O	106	GLU	2.3
1	O	256	ASP	2.2
1	O	24	ASN	2.2
1	P	256	ASP	2.0
1	O	82	PRO	2.0
1	P	194	LYS	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)

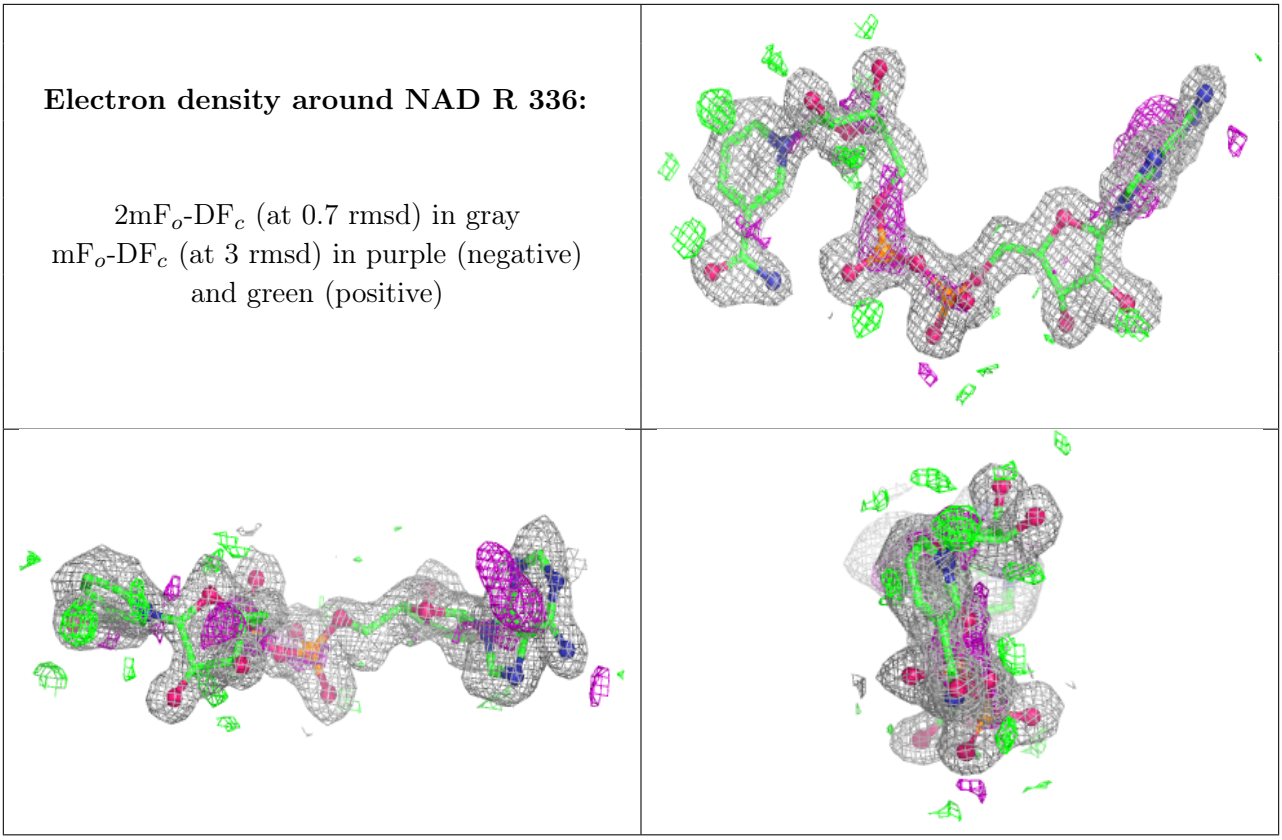
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9'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

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	NAD	R	336	44/44	0.87	0.12	20,27,28,30	0
2	NAD	Q	336	44/44	0.91	0.10	17,22,23,24	0
2	NAD	P	336	44/44	0.95	0.07	12,16,19,19	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.

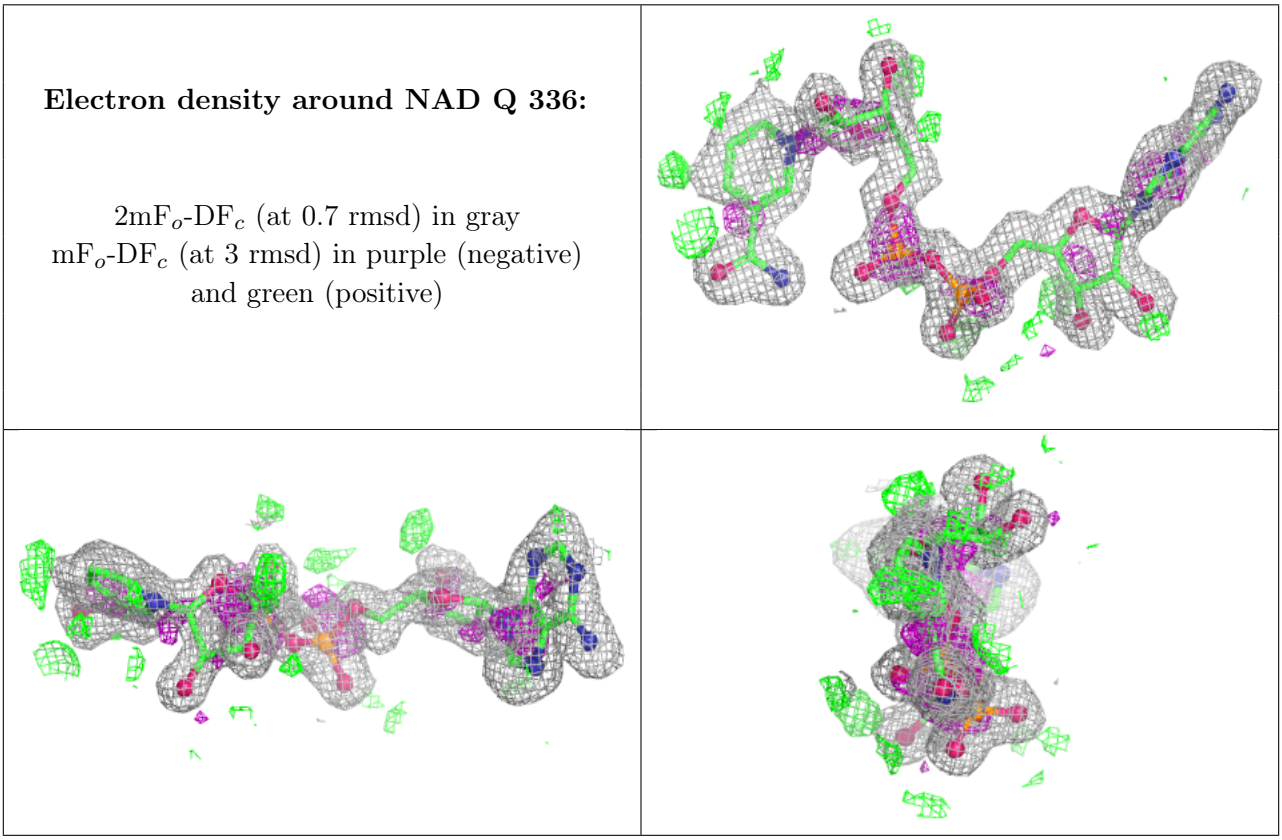
Electron density around NAD R 336:

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



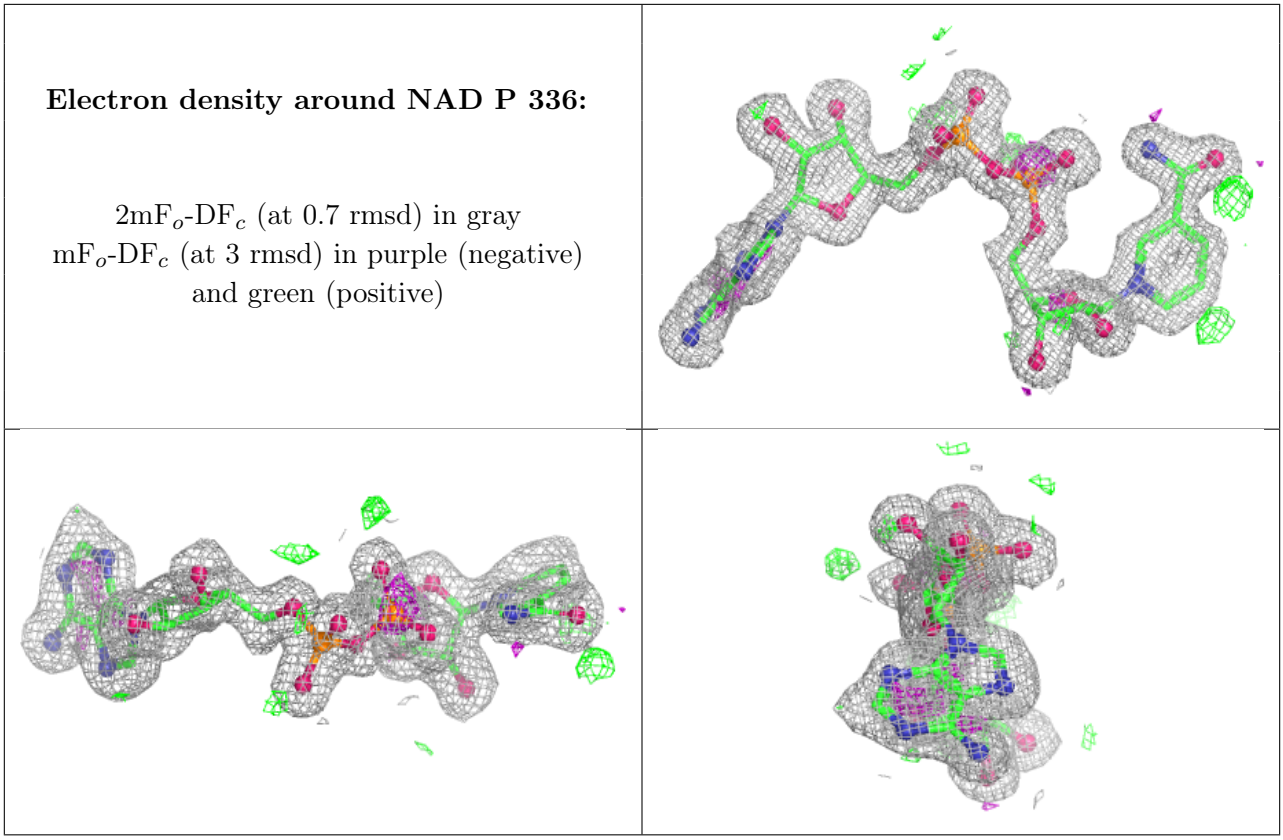
Electron density around NAD Q 336:

$2mF_o$-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 P 336:

$2mF_o$-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.