



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 11, 2024 – 10:32 PM EDT

PDB ID : 1HWY  
Title : BOVINE GLUTAMATE DEHYDROGENASE COMPLEXED WITH NAD  
AND 2-OXOGLUTARATE  
Authors : Smith, T.J.; Peterson, P.E.; Schmidt, T.; Fang, J.; Stanley, C.A.  
Deposited on : 2001-01-10  
Resolution : 3.20 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

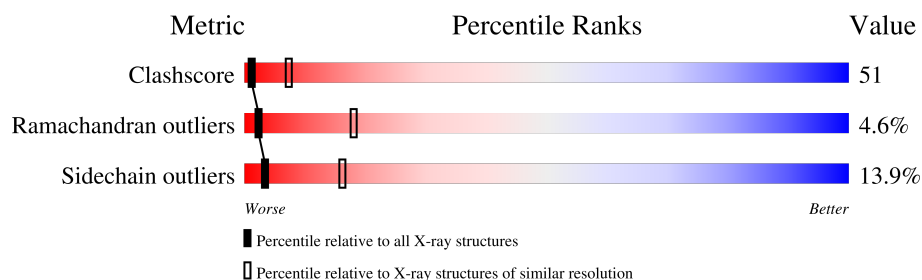
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.20 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))
Clashscore	141614	1253 (3.20-3.20)
Ramachandran outliers	138981	1234 (3.20-3.20)
Sidechain outliers	138945	1233 (3.20-3.20)

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  $\leq 5\%$ .

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	501	<div> <div>34%</div> <div>52%</div> <div>12%</div> <div>.</div> </div>
1	B	501	<div> <div>32%</div> <div>54%</div> <div>12%</div> <div>.</div> </div>
1	C	501	<div> <div>32%</div> <div>55%</div> <div>12%</div> <div>.</div> </div>
1	D	501	<div> <div>33%</div> <div>53%</div> <div>12%</div> <div>.</div> </div>
1	E	501	<div> <div>32%</div> <div>54%</div> <div>13%</div> <div>.</div> </div>
1	F	501	<div> <div>32%</div> <div>54%</div> <div>12%</div> <div>.</div> </div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	PO4	A	502	-	-	X	-
2	PO4	A	504	-	-	X	-
2	PO4	B	503	-	-	X	-
2	PO4	B	505	-	-	X	-
2	PO4	C	503	-	-	X	-
2	PO4	C	505	-	-	X	-
2	PO4	D	503	-	-	X	-
2	PO4	D	504	-	-	X	-
2	PO4	E	503	-	-	X	-
2	PO4	E	504	-	-	X	-
2	PO4	F	502	-	-	X	-
2	PO4	F	504	-	-	X	-
3	AKG	A	506	-	-	X	-
3	AKG	B	506	-	-	X	-
3	AKG	C	506	-	-	X	-
3	AKG	D	506	-	-	X	-
3	AKG	E	506	-	-	X	-
3	AKG	F	506	-	-	X	-

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 24468 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 GLUTAMATE DEHYDROGENASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	501	Total	C	N	O	S	0	0	0
			3910	2468	690	733	19			
1	B	501	Total	C	N	O	S	0	0	0
			3910	2468	690	733	19			
1	C	501	Total	C	N	O	S	0	0	0
			3910	2468	690	733	19			
1	D	501	Total	C	N	O	S	0	0	0
			3910	2468	690	733	19			
1	E	501	Total	C	N	O	S	0	0	0
			3910	2468	690	733	19			
1	F	501	Total	C	N	O	S	0	0	0
			3910	2468	690	733	19			

There are 30 discrepancies between the modelled and reference sequences:

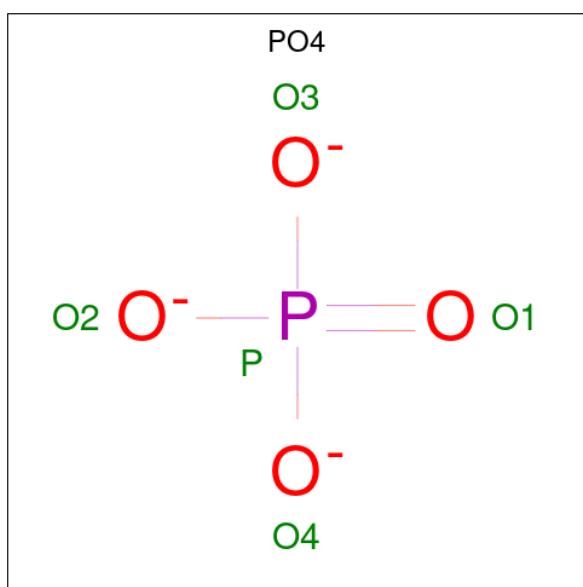
Chain	Residue	Modelled	Actual	Comment	Reference
A	200	GLY	LYS	SEE REMARK 999	UNP P00366
A	201	LYS	PRO	SEE REMARK 999	UNP P00366
A	202	PRO	GLY	SEE REMARK 999	UNP P00366
A	221	HIS	GLY	SEE REMARK 999	UNP P00366
A	222	GLY	HIS	SEE REMARK 999	UNP P00366
B	200	GLY	LYS	SEE REMARK 999	UNP P00366
B	201	LYS	PRO	SEE REMARK 999	UNP P00366
B	202	PRO	GLY	SEE REMARK 999	UNP P00366
B	221	HIS	GLY	SEE REMARK 999	UNP P00366
B	222	GLY	HIS	SEE REMARK 999	UNP P00366
C	200	GLY	LYS	SEE REMARK 999	UNP P00366
C	201	LYS	PRO	SEE REMARK 999	UNP P00366
C	202	PRO	GLY	SEE REMARK 999	UNP P00366
C	221	HIS	GLY	SEE REMARK 999	UNP P00366
C	222	GLY	HIS	SEE REMARK 999	UNP P00366
D	200	GLY	LYS	SEE REMARK 999	UNP P00366
D	201	LYS	PRO	SEE REMARK 999	UNP P00366

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Chain	Residue	Modelled	Actual	Comment	Reference
D	202	PRO	GLY	SEE REMARK 999	UNP P00366
D	221	HIS	GLY	SEE REMARK 999	UNP P00366
D	222	GLY	HIS	SEE REMARK 999	UNP P00366
E	200	GLY	LYS	SEE REMARK 999	UNP P00366
E	201	LYS	PRO	SEE REMARK 999	UNP P00366
E	202	PRO	GLY	SEE REMARK 999	UNP P00366
E	221	HIS	GLY	SEE REMARK 999	UNP P00366
E	222	GLY	HIS	SEE REMARK 999	UNP P00366
F	200	GLY	LYS	SEE REMARK 999	UNP P00366
F	201	LYS	PRO	SEE REMARK 999	UNP P00366
F	202	PRO	GLY	SEE REMARK 999	UNP P00366
F	221	HIS	GLY	SEE REMARK 999	UNP P00366
F	222	GLY	HIS	SEE REMARK 999	UNP P00366

- Molecule 2 is PHOSPHATE ION (three-letter code: PO4) (formula: O<sub>4</sub>P).



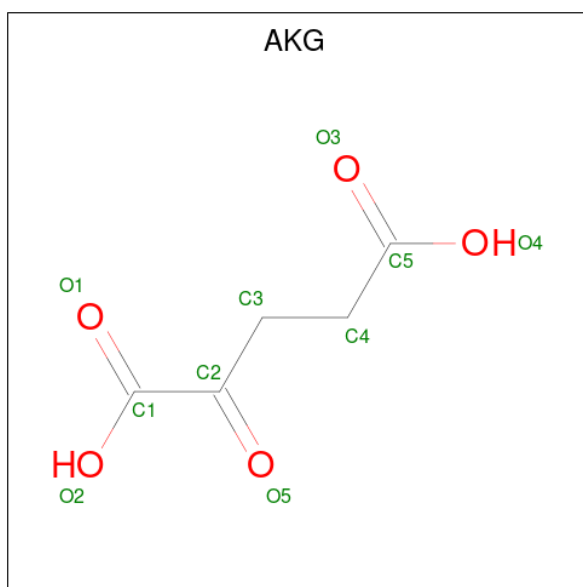
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	P	0	0
			5	4	1		
2	A	1	Total	O	P	0	0
			5	4	1		
2	A	1	Total	O	P	0	0
			5	4	1		
2	A	1	Total	O	P	0	0
			5	4	1		
2	B	1	Total	O	P	0	0
			5	4	1		

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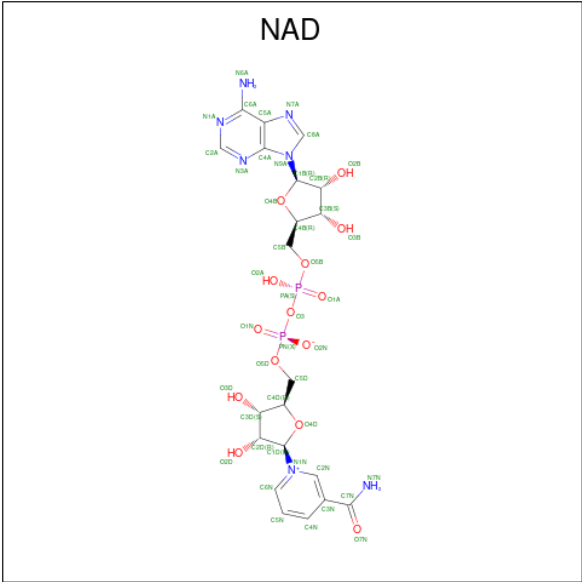
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	B	1	Total	O	P	0	0
			5	4	1		
2	B	1	Total	O	P	0	0
			5	4	1		
2	B	1	Total	O	P	0	0
			5	4	1		
2	C	1	Total	O	P	0	0
			5	4	1		
2	C	1	Total	O	P	0	0
			5	4	1		
2	C	1	Total	O	P	0	0
			5	4	1		
2	C	1	Total	O	P	0	0
			5	4	1		
2	D	1	Total	O	P	0	0
			5	4	1		
2	D	1	Total	O	P	0	0
			5	4	1		
2	D	1	Total	O	P	0	0
			5	4	1		
2	D	1	Total	O	P	0	0
			5	4	1		
2	E	1	Total	O	P	0	0
			5	4	1		
2	E	1	Total	O	P	0	0
			5	4	1		
2	E	1	Total	O	P	0	0
			5	4	1		
2	E	1	Total	O	P	0	0
			5	4	1		
2	F	1	Total	O	P	0	0
			5	4	1		
2	F	1	Total	O	P	0	0
			5	4	1		
2	F	1	Total	O	P	0	0
			5	4	1		

- Molecule 3 is 2-OXOGLUTARIC ACID (three-letter code: AKG) (formula: C<sub>5</sub>H<sub>6</sub>O<sub>5</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			10	5	5		
3	B	1	Total	C	O	0	0
			10	5	5		
3	C	1	Total	C	O	0	0
			10	5	5		
3	D	1	Total	C	O	0	0
			10	5	5		
3	E	1	Total	C	O	0	0
			10	5	5		
3	F	1	Total	C	O	0	0
			10	5	5		

- Molecule 4 is NICOTINAMIDE-ADENINE-DINUCLEOTIDE (three-letter code: NAD) (formula:  $C_{21}H_{27}N_7O_{14}P_2$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	1
			88	42	14	28	4		
4	A	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
4	B	1	Total	C	N	O	P	0	1
			88	42	14	28	4		
4	B	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
4	C	1	Total	C	N	O	P	0	1
			88	42	14	28	4		
4	C	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
4	D	1	Total	C	N	O	P	0	1
			88	42	14	28	4		
4	D	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
4	E	1	Total	C	N	O	P	0	1
			88	42	14	28	4		
4	E	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
4	F	1	Total	C	N	O	P	0	0
			44	21	7	14	2		
4	F	1	Total	C	N	O	P	0	1
			88	42	14	28	4		

- Molecule 5 is water.



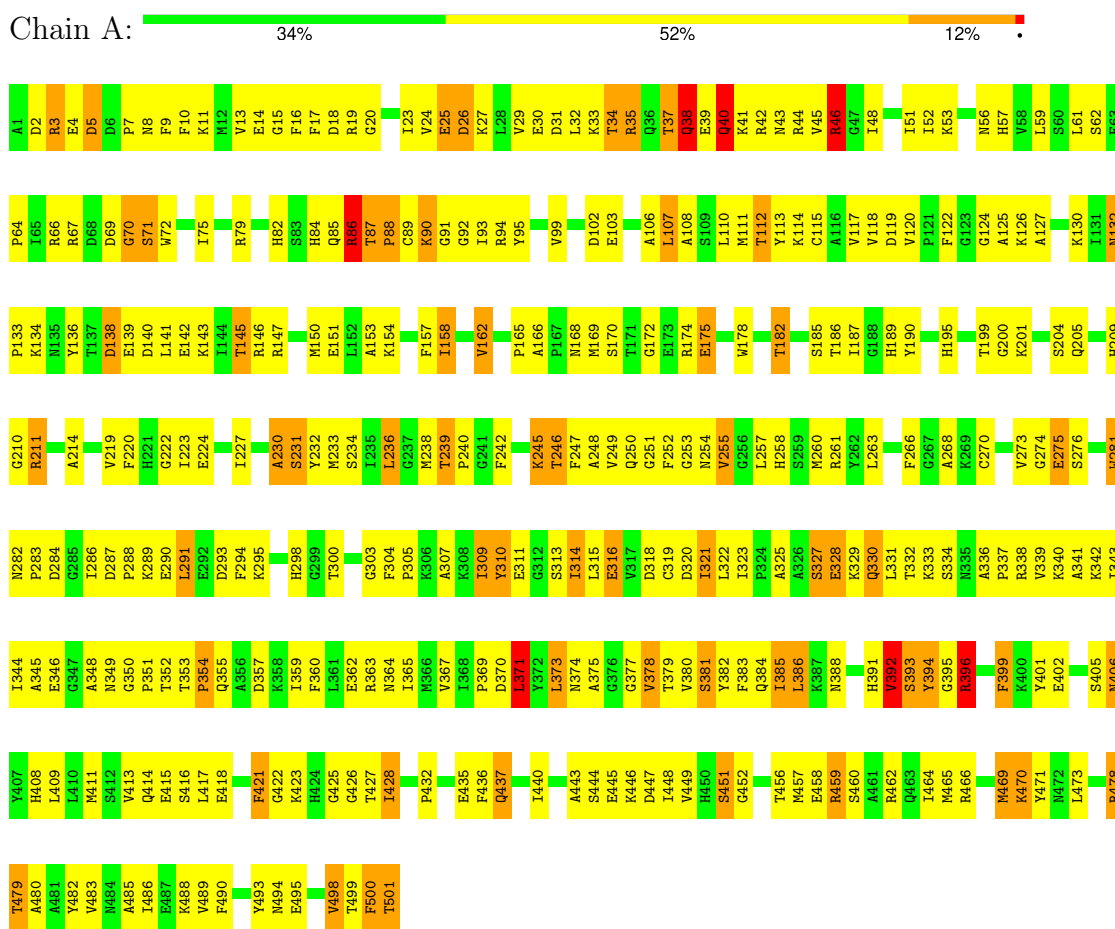
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	6	Total 6	O 6	0	0
5	B	6	Total 6	O 6	0	0
5	C	6	Total 6	O 6	0	0
5	D	6	Total 6	O 6	0	0
5	E	6	Total 6	O 6	0	0
5	F	6	Total 6	O 6	0	0

### 3 Residue-property plots

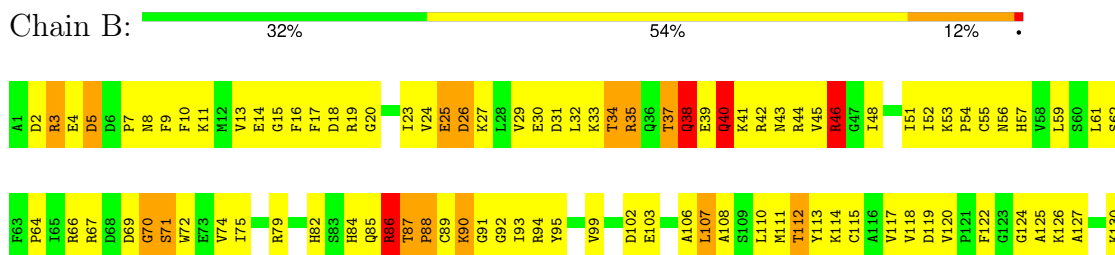
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

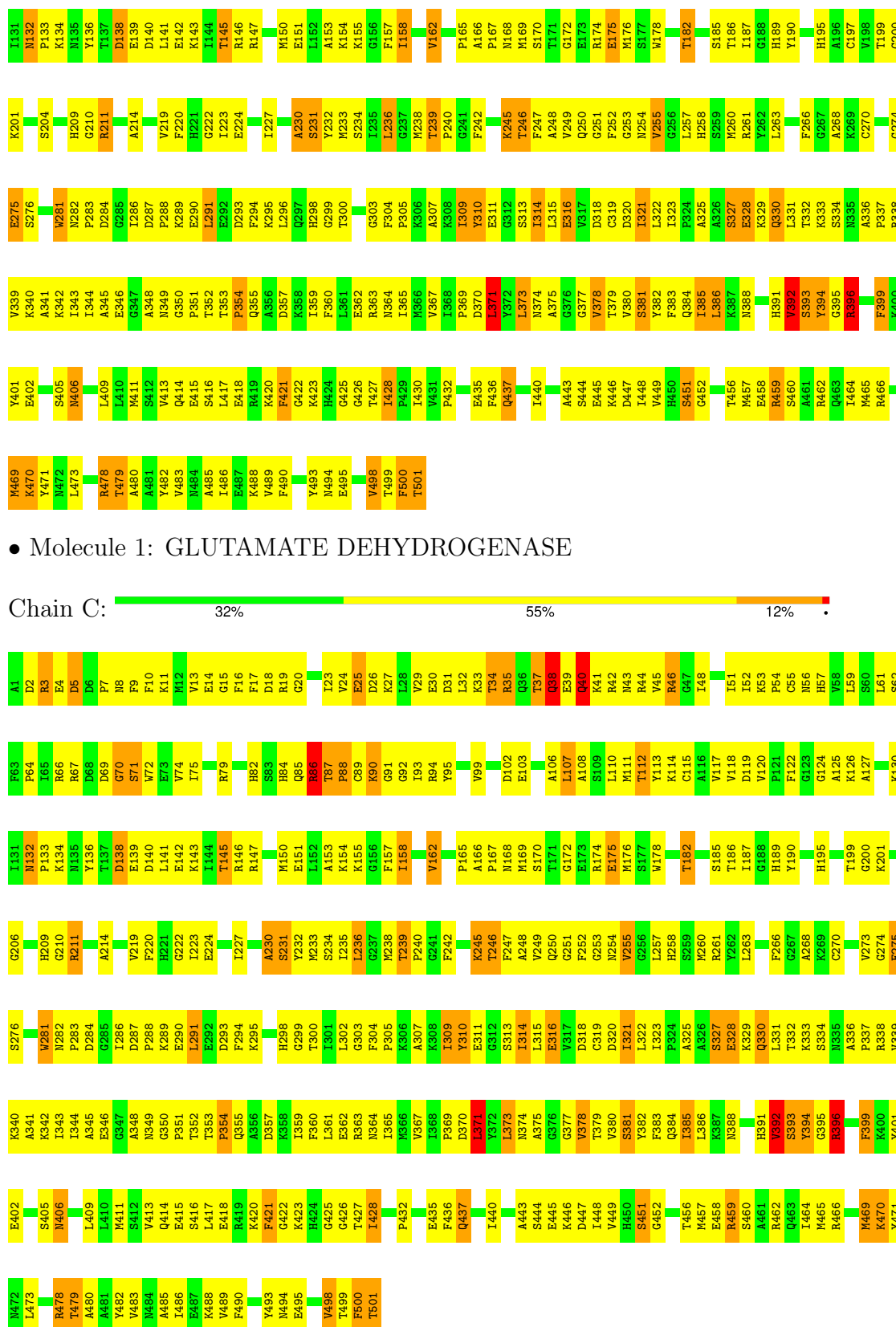
Note EDS was not executed.

#### • Molecule 1: GLUTAMATE DEHYDROGENASE

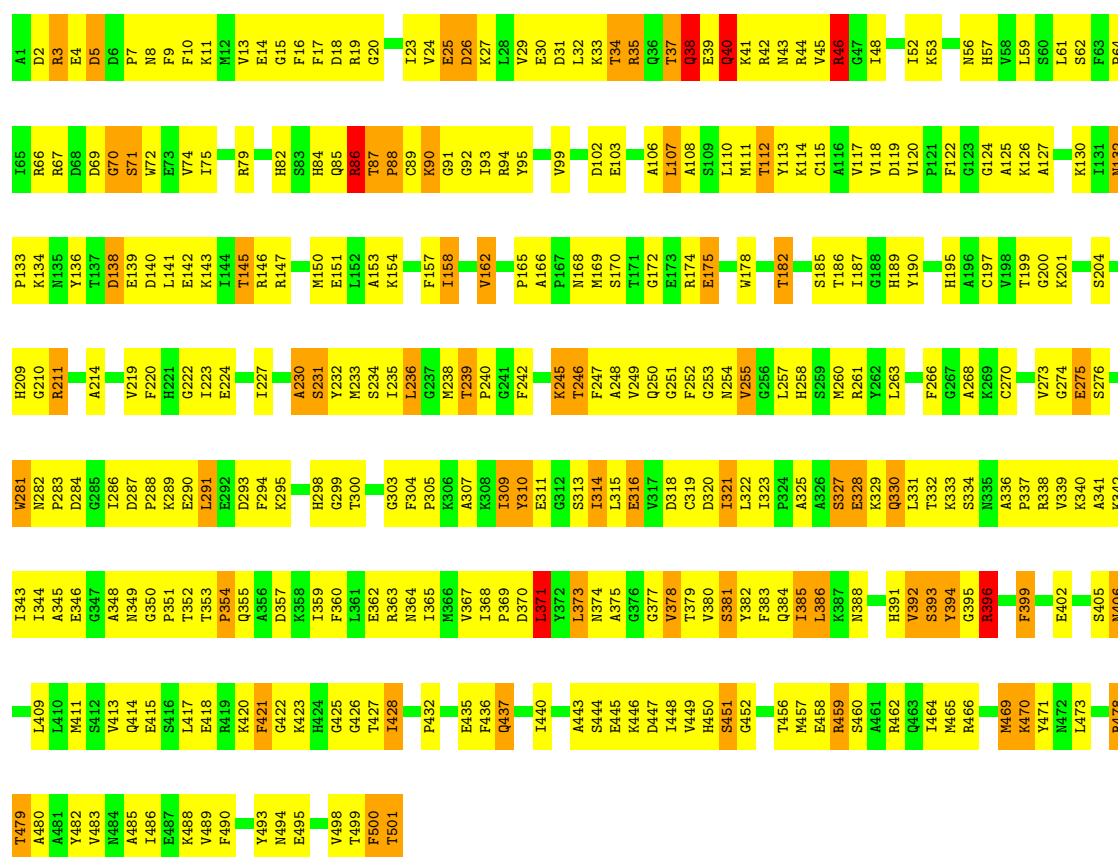


#### • Molecule 1: GLUTAMATE DEHYDROGENASE



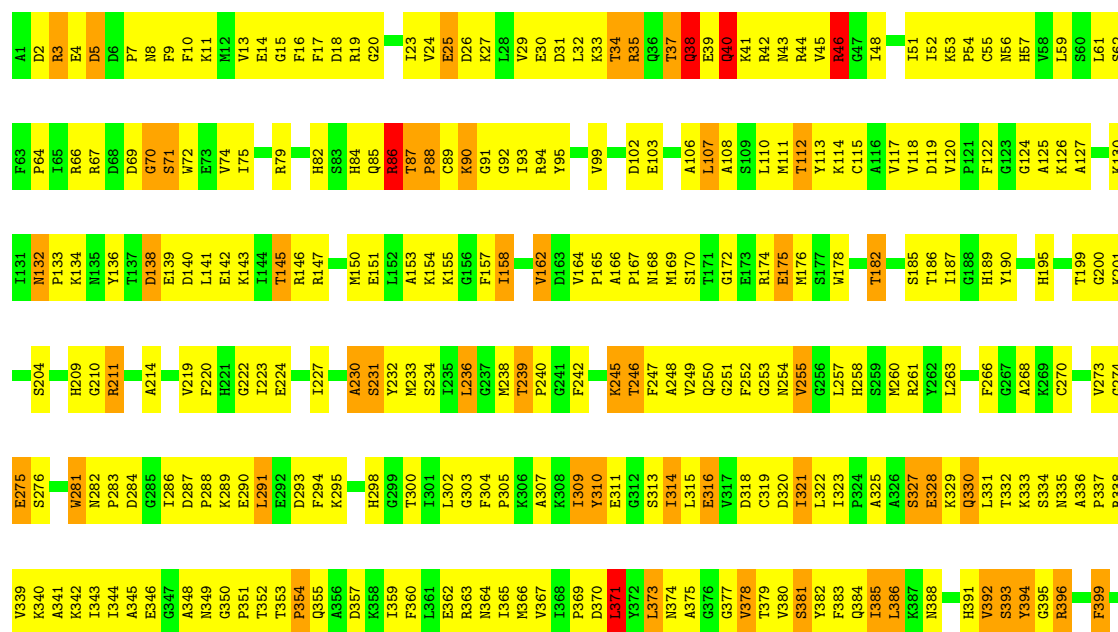


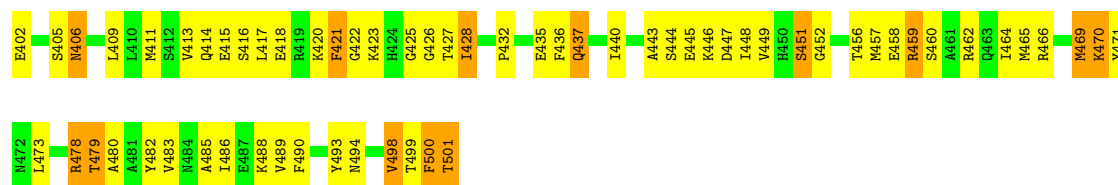
Chain D:  33% 53% 12%



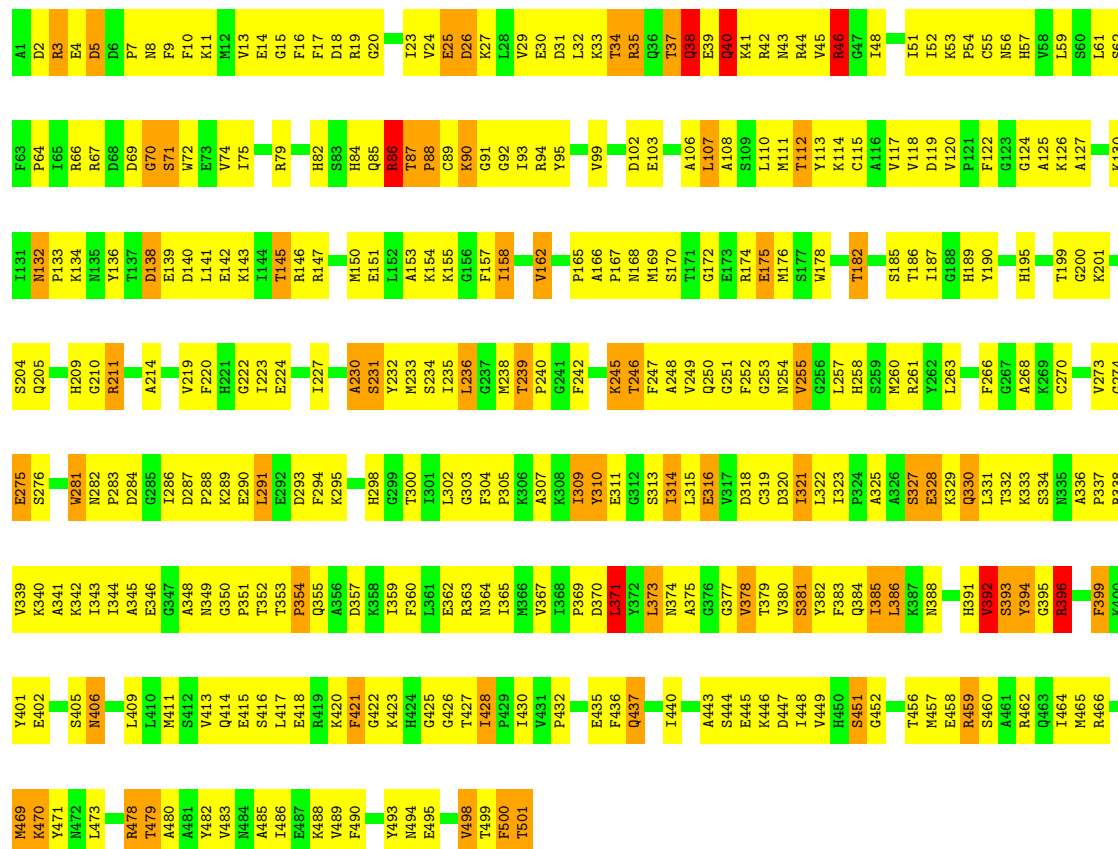
- Molecule 1: GLUTAMATE DEHYDROGENASE

Chain E:  32% 54% 13%





• Molecule 1: GLUTAMATE DEHYDROGENASE



## 4 Data and refinement statistics

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

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	122.50Å 101.00Å 164.60Å 90.00° 102.20° 90.00°	Depositor
Resolution (Å)	8.00 – 3.20	Depositor
% Data completeness (in resolution range)	(Not available) (8.00-3.20)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	X-PLOR	Depositor
R, $R_{free}$	0.230 , 0.290	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	24468	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	10.0	wwPDB-VP

## 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: AKG, PO4, 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	0.62	0/3991	0.84	10/5384 (0.2%)
1	B	0.62	0/3991	0.84	10/5384 (0.2%)
1	C	0.62	0/3991	0.84	9/5384 (0.2%)
1	D	0.62	0/3991	0.84	10/5384 (0.2%)
1	E	0.62	0/3991	0.84	10/5384 (0.2%)
1	F	0.62	0/3991	0.84	10/5384 (0.2%)
All	All	0.62	0/23946	0.84	59/32304 (0.2%)

There are no bond length outliers.

The worst 5 of 59 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	478	ARG	NE-CZ-NH1	-6.37	117.11	120.30
1	B	478	ARG	NE-CZ-NH1	-6.35	117.12	120.30
1	A	478	ARG	NE-CZ-NH1	-6.32	117.14	120.30
1	E	478	ARG	NE-CZ-NH1	-6.30	117.15	120.30
1	C	478	ARG	NE-CZ-NH1	-6.28	117.16	120.30

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	3910	0	3888	431	1
1	B	3910	0	3888	453	2
1	C	3910	0	3888	431	2
1	D	3910	0	3888	419	0
1	E	3910	0	3888	437	1
1	F	3910	0	3888	444	0
2	A	20	0	0	6	0
2	B	20	0	0	6	0
2	C	20	0	0	6	0
2	D	20	0	0	6	0
2	E	20	0	0	6	0
2	F	20	0	0	6	0
3	A	10	0	4	6	0
3	B	10	0	4	7	0
3	C	10	0	4	7	0
3	D	10	0	4	7	0
3	E	10	0	4	7	0
3	F	10	0	4	7	0
4	A	132	0	78	32	0
4	B	132	0	78	35	0
4	C	132	0	78	38	0
4	D	132	0	77	34	0
4	E	132	0	77	30	0
4	F	132	0	77	33	0
5	A	6	0	0	4	0
5	B	6	0	0	4	0
5	C	6	0	0	4	0
5	D	6	0	0	5	0
5	E	6	0	0	4	0
5	F	6	0	0	4	0
All	All	24468	0	23817	2472	3

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 51.

The worst 5 of 2472 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:D:391:HIS:CA	4:D:507[A]:NAD:O3D	1.66	1.41
1:F:391:HIS:CA	4:F:508[A]:NAD:O3D	1.66	1.41
1:B:391:HIS:CA	4:B:507[A]:NAD:O3D	1.69	1.40
1:C:391:HIS:CA	4:C:507[A]:NAD:O3D	1.70	1.39

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:391:HIS:CA	4:A:507[A]:NAD:O3D	1.69	1.38

All (3) 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)
1:A:3:ARG:CZ	1:E:298:HIS:NE2[2_556]	2.14	0.06
1:B:309:ILE:CG1	1:C:284:ASP:OD1[2_545]	2.14	0.06
1:B:69:ASP:O	1:C:3:ARG:NH2[2_545]	2.19	0.01

## 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	499/501 (100%)	417 (84%)	59 (12%)	23 (5%)	2	18
1	B	499/501 (100%)	417 (84%)	59 (12%)	23 (5%)	2	18
1	C	499/501 (100%)	417 (84%)	59 (12%)	23 (5%)	2	18
1	D	499/501 (100%)	417 (84%)	59 (12%)	23 (5%)	2	18
1	E	499/501 (100%)	417 (84%)	59 (12%)	23 (5%)	2	18
1	F	499/501 (100%)	417 (84%)	59 (12%)	23 (5%)	2	18
All	All	2994/3006 (100%)	2502 (84%)	354 (12%)	138 (5%)	2	18

5 of 138 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	5	ASP
1	A	35	ARG
1	A	70	GLY
1	B	5	ASP
1	B	35	ARG

### 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	417/417 (100%)	359 (86%)	58 (14%)	3	16
1	B	417/417 (100%)	359 (86%)	58 (14%)	3	16
1	C	417/417 (100%)	359 (86%)	58 (14%)	3	16
1	D	417/417 (100%)	359 (86%)	58 (14%)	3	16
1	E	417/417 (100%)	359 (86%)	58 (14%)	3	16
1	F	417/417 (100%)	359 (86%)	58 (14%)	3	16
All	All	2502/2502 (100%)	2154 (86%)	348 (14%)	3	16

5 of 348 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	501	THR
1	E	469	MET
1	E	90	LYS
1	E	310	TYR
1	F	130	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 103 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	168	ASN
1	E	57	HIS
1	F	391	HIS
1	D	195	HIS
1	D	391	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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

48 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	$\# Z  > 2$
3	AKG	B	506	-	9,9,9	1.75	2 (22%)	11,11,11	3.30	5 (45%)
2	PO4	C	504	-	4,4,4	2.00	1 (25%)	6,6,6	0.90	0
2	PO4	F	502	-	4,4,4	1.27	1 (25%)	6,6,6	0.92	0
2	PO4	C	505	-	4,4,4	1.25	1 (25%)	6,6,6	0.92	0
2	PO4	D	504	-	4,4,4	1.26	1 (25%)	6,6,6	0.91	0
4	NAD	A	507[A]	-	42,48,48	2.75	12 (28%)	50,73,73	2.51	14 (28%)
3	AKG	C	506	-	9,9,9	1.76	2 (22%)	11,11,11	3.30	5 (45%)
4	NAD	F	507	-	42,48,48	2.81	15 (35%)	50,73,73	2.42	17 (34%)
2	PO4	E	503	-	4,4,4	1.27	1 (25%)	6,6,6	0.92	0
4	NAD	B	507[A]	-	42,48,48	2.74	12 (28%)	50,73,73	2.51	14 (28%)
2	PO4	D	502	-	4,4,4	1.25	1 (25%)	6,6,6	0.91	0
4	NAD	F	508[A]	-	42,48,48	2.74	12 (28%)	50,73,73	2.51	14 (28%)
2	PO4	C	503	-	4,4,4	1.26	1 (25%)	6,6,6	0.92	0
4	NAD	A	507[B]	-	42,48,48	2.90	15 (35%)	50,73,73	2.19	17 (34%)
4	NAD	D	508	-	42,48,48	2.80	15 (35%)	50,73,73	2.43	17 (34%)
2	PO4	F	503	-	4,4,4	1.25	1 (25%)	6,6,6	0.92	0
2	PO4	B	502	-	4,4,4	1.25	1 (25%)	6,6,6	0.91	0
2	PO4	E	502	-	4,4,4	1.24	1 (25%)	6,6,6	0.91	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
4	NAD	D	507[A]	-	42,48,48	2.74	12 (28%)	50,73,73	2.51	14 (28%)
4	NAD	A	508	-	42,48,48	2.80	15 (35%)	50,73,73	2.43	17 (34%)
4	NAD	E	508	-	42,48,48	2.81	15 (35%)	50,73,73	2.43	17 (34%)
4	NAD	B	507[B]	-	42,48,48	2.90	15 (35%)	50,73,73	2.18	17 (34%)
2	PO4	F	504	-	4,4,4	1.27	1 (25%)	6,6,6	0.92	0
4	NAD	F	508[B]	-	42,48,48	2.90	15 (35%)	50,73,73	2.19	17 (34%)
2	PO4	D	503	-	4,4,4	1.25	1 (25%)	6,6,6	0.91	0
4	NAD	C	507[A]	-	42,48,48	2.74	12 (28%)	50,73,73	2.52	14 (28%)
3	AKG	E	506	-	9,9,9	1.76	2 (22%)	11,11,11	3.29	5 (45%)
2	PO4	D	505	-	4,4,4	1.98	1 (25%)	6,6,6	0.90	0
3	AKG	D	506	-	9,9,9	1.75	2 (22%)	11,11,11	3.31	5 (45%)
4	NAD	E	507[B]	-	42,48,48	2.91	15 (35%)	50,73,73	2.18	17 (34%)
3	AKG	F	506	-	9,9,9	1.76	2 (22%)	11,11,11	3.30	5 (45%)
2	PO4	B	503	-	4,4,4	1.26	1 (25%)	6,6,6	0.92	0
4	NAD	D	507[B]	-	42,48,48	2.90	15 (35%)	50,73,73	2.18	17 (34%)
4	NAD	E	507[A]	-	42,48,48	2.73	12 (28%)	50,73,73	2.51	14 (28%)
2	PO4	A	504	-	4,4,4	1.26	1 (25%)	6,6,6	0.91	0
4	NAD	C	508	-	42,48,48	2.81	15 (35%)	50,73,73	2.43	17 (34%)
2	PO4	A	502	-	4,4,4	1.26	1 (25%)	6,6,6	0.92	0
2	PO4	E	505	-	4,4,4	1.99	1 (25%)	6,6,6	0.90	0
4	NAD	C	507[B]	-	42,48,48	2.90	15 (35%)	50,73,73	2.19	17 (34%)
2	PO4	B	504	-	4,4,4	1.99	1 (25%)	6,6,6	0.90	0
3	AKG	A	506	-	9,9,9	1.75	2 (22%)	11,11,11	3.30	5 (45%)
2	PO4	B	505	-	4,4,4	1.25	1 (25%)	6,6,6	0.91	0
2	PO4	E	504	-	4,4,4	1.26	1 (25%)	6,6,6	0.91	0
2	PO4	A	505	-	4,4,4	1.99	1 (25%)	6,6,6	0.90	0
4	NAD	B	508	-	42,48,48	2.80	15 (35%)	50,73,73	2.42	17 (34%)
2	PO4	F	505	-	4,4,4	1.99	1 (25%)	6,6,6	0.90	0
2	PO4	A	503	-	4,4,4	1.25	1 (25%)	6,6,6	0.91	0
2	PO4	C	502	-	4,4,4	1.25	1 (25%)	6,6,6	0.91	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
3	AKG	B	506	-	-	4/9/9/9	-
4	NAD	A	507[A]	-	-	9/26/62/62	0/5/5/5
3	AKG	C	506	-	-	4/9/9/9	-
4	NAD	F	507	-	-	11/26/62/62	0/5/5/5
4	NAD	B	507[A]	-	-	9/26/62/62	0/5/5/5
4	NAD	F	508[A]	-	-	9/26/62/62	0/5/5/5
4	NAD	A	507[B]	-	-	8/26/62/62	0/5/5/5
4	NAD	D	508	-	-	11/26/62/62	0/5/5/5
4	NAD	D	507[A]	-	-	9/26/62/62	0/5/5/5
4	NAD	A	508	-	-	11/26/62/62	0/5/5/5
4	NAD	E	508	-	-	11/26/62/62	0/5/5/5
4	NAD	B	507[B]	-	-	8/26/62/62	0/5/5/5
4	NAD	F	508[B]	-	-	8/26/62/62	0/5/5/5
4	NAD	C	507[A]	-	-	9/26/62/62	0/5/5/5
3	AKG	E	506	-	-	4/9/9/9	-
3	AKG	D	506	-	-	4/9/9/9	-
3	AKG	F	506	-	-	4/9/9/9	-
4	NAD	D	507[B]	-	-	8/26/62/62	0/5/5/5
4	NAD	E	507[A]	-	-	9/26/62/62	0/5/5/5
4	NAD	C	508	-	-	11/26/62/62	0/5/5/5
4	NAD	C	507[B]	-	-	8/26/62/62	0/5/5/5
3	AKG	A	506	-	-	4/9/9/9	-
4	NAD	B	508	-	-	11/26/62/62	0/5/5/5
4	NAD	E	507[B]	-	-	8/26/62/62	0/5/5/5

The worst 5 of 288 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	507[A]	NAD	PN-O3	8.78	1.69	1.59
4	A	507[A]	NAD	PN-O3	8.75	1.68	1.59
4	D	507[A]	NAD	PN-O3	8.74	1.68	1.59
4	F	508[A]	NAD	PN-O3	8.73	1.68	1.59
4	E	507[A]	NAD	PN-O3	8.71	1.68	1.59

The worst 5 of 318 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	508	NAD	O4B-C1B-N9A	-7.46	98.86	108.75

*Continued on next page...*

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	E	508	NAD	O4B-C1B-N9A	-7.44	98.88	108.75
4	C	508	NAD	O4B-C1B-N9A	-7.42	98.91	108.75
4	A	508	NAD	O4B-C1B-N9A	-7.41	98.92	108.75
4	B	508	NAD	O4B-C1B-N9A	-7.41	98.92	108.75

There are no chirality outliers.

5 of 192 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	506	AKG	C1-C2-C3-C4
3	B	506	AKG	C1-C2-C3-C4
3	C	506	AKG	C1-C2-C3-C4
3	D	506	AKG	C1-C2-C3-C4
3	E	506	AKG	C1-C2-C3-C4

There are no ring outliers.

48 monomers are involved in 257 short contacts:

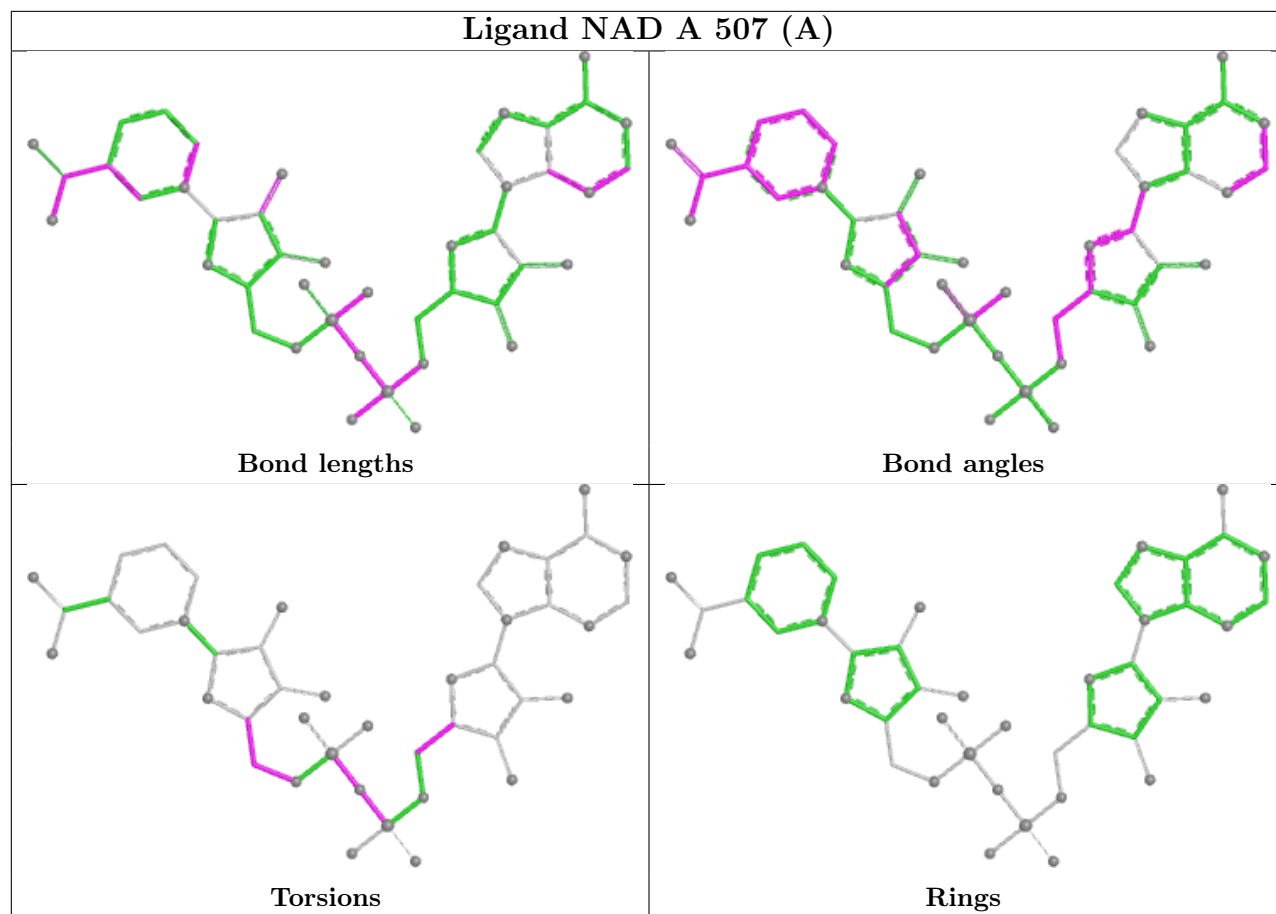
Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	506	AKG	7	0
2	C	504	PO4	1	0
2	F	502	PO4	2	0
2	C	505	PO4	2	0
2	D	504	PO4	2	0
4	A	507[A]	NAD	16	0
3	C	506	AKG	7	0
4	F	507	NAD	12	0
2	E	503	PO4	2	0
4	B	507[A]	NAD	17	0
2	D	502	PO4	1	0
4	F	508[A]	NAD	14	0
2	C	503	PO4	2	0
4	A	507[B]	NAD	6	0
4	D	508	NAD	11	0
2	F	503	PO4	1	0
2	B	502	PO4	1	0
2	E	502	PO4	1	0
4	D	507[A]	NAD	16	0
4	A	508	NAD	10	0
4	E	508	NAD	11	0
4	B	507[B]	NAD	7	0

*Continued on next page...*

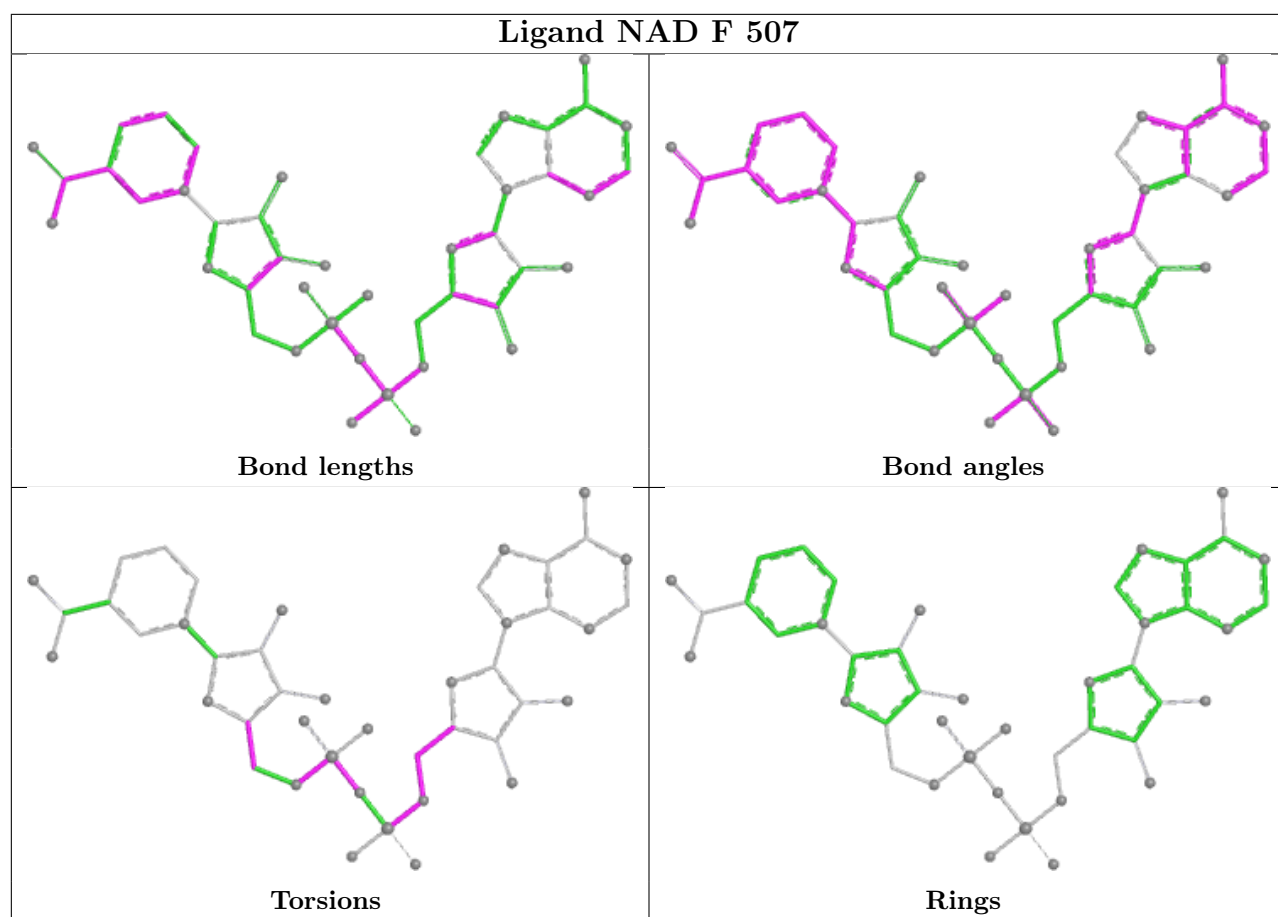
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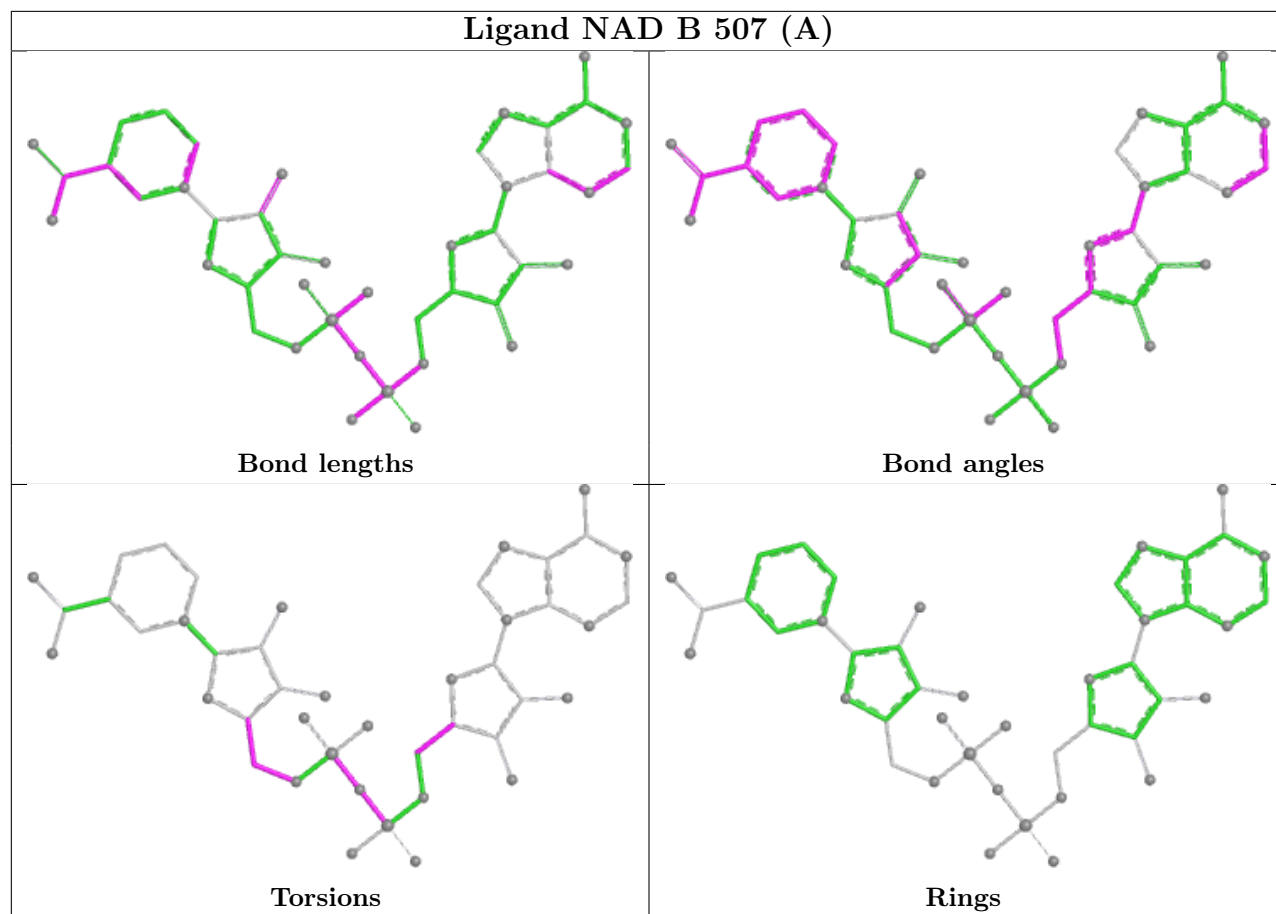
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	F	504	PO4	2	0
4	F	508[B]	NAD	7	0
2	D	503	PO4	2	0
4	C	507[A]	NAD	19	0
3	E	506	AKG	7	0
2	D	505	PO4	1	0
3	D	506	AKG	7	0
4	E	507[B]	NAD	7	0
3	F	506	AKG	7	0
2	B	503	PO4	2	0
4	D	507[B]	NAD	7	0
4	E	507[A]	NAD	12	0
2	A	504	PO4	2	0
4	C	508	NAD	12	0
2	A	502	PO4	2	0
2	E	505	PO4	1	0
4	C	507[B]	NAD	7	0
2	B	504	PO4	1	0
3	A	506	AKG	6	0
2	B	505	PO4	2	0
2	E	504	PO4	2	0
2	A	505	PO4	1	0
4	B	508	NAD	11	0
2	F	505	PO4	1	0
2	A	503	PO4	1	0
2	C	502	PO4	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.

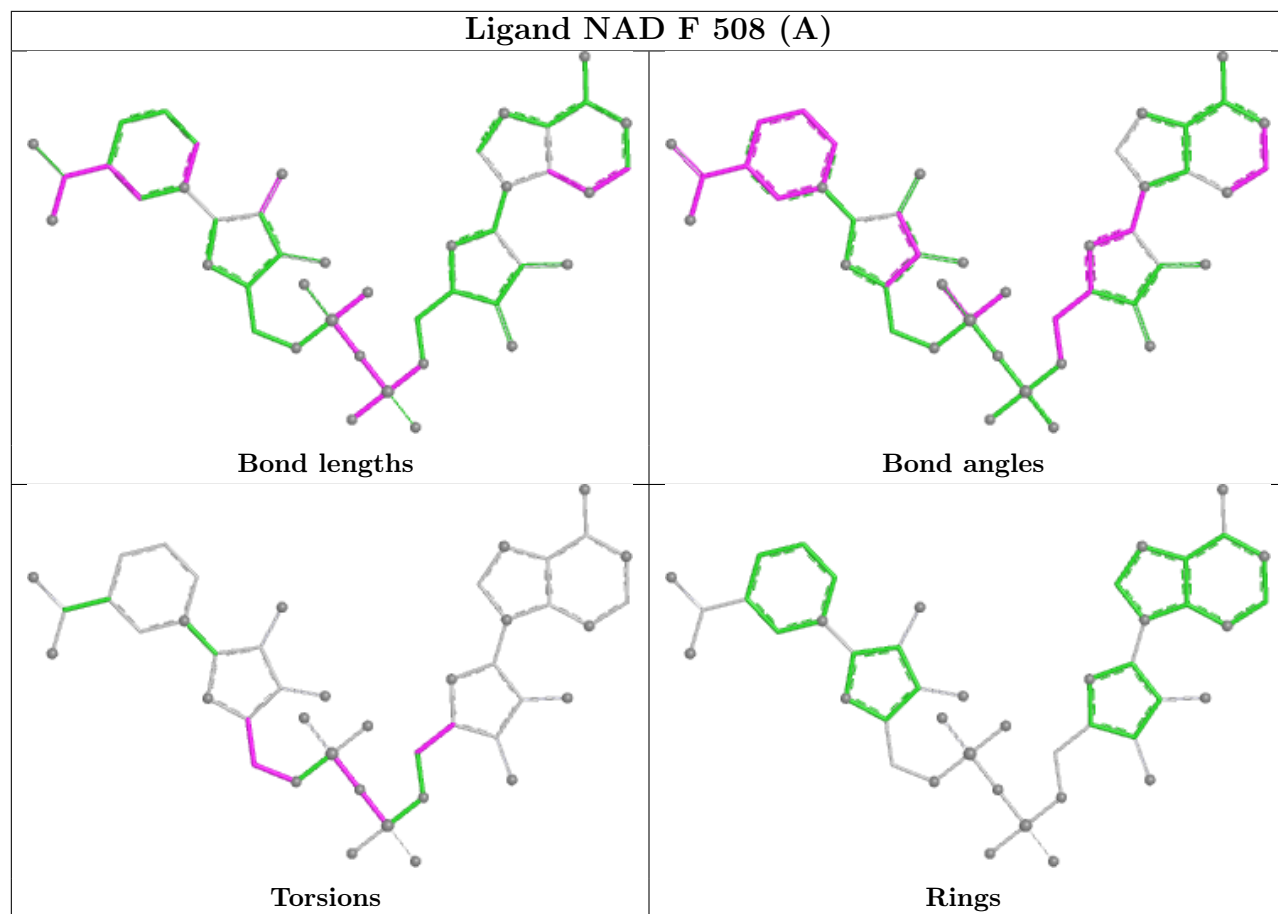




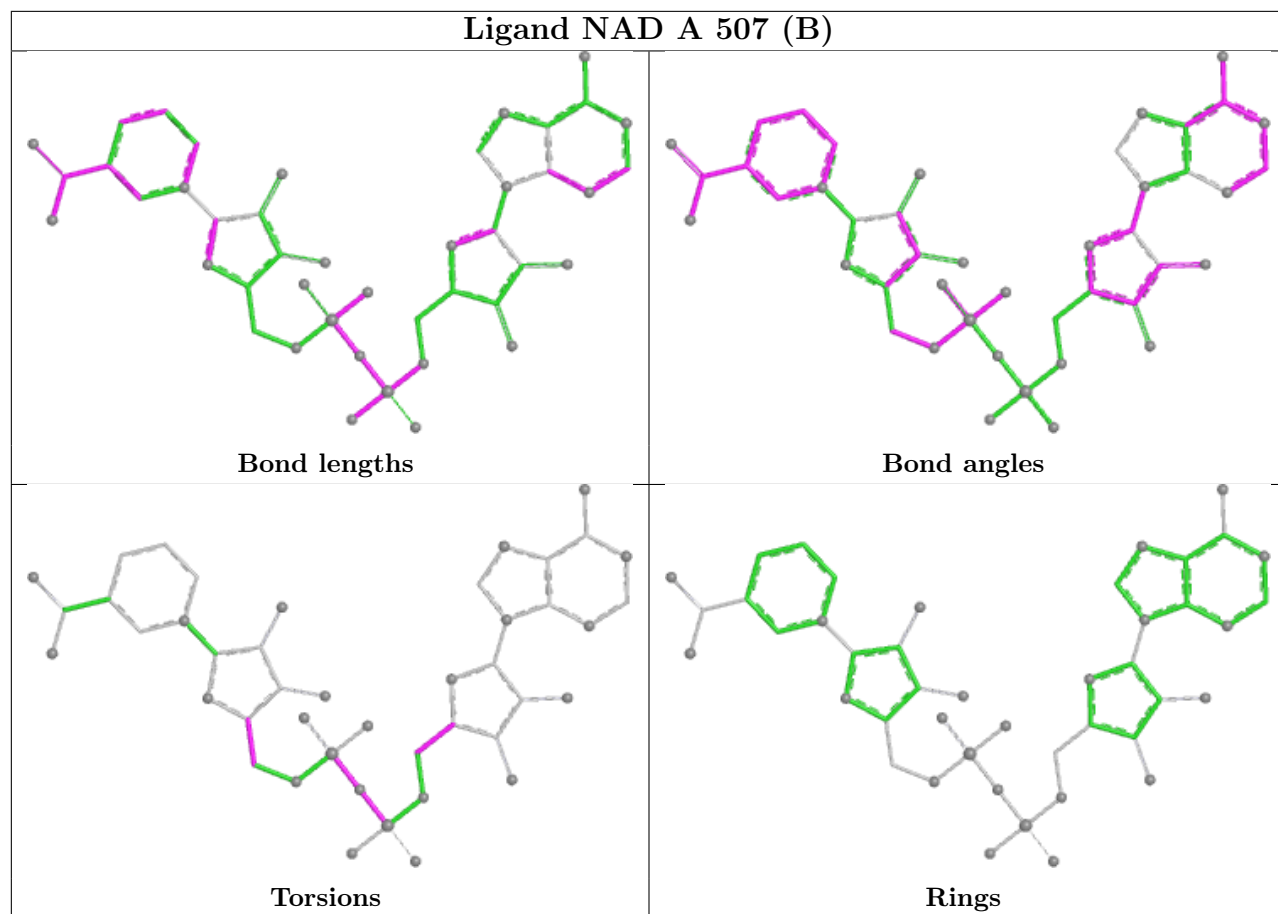


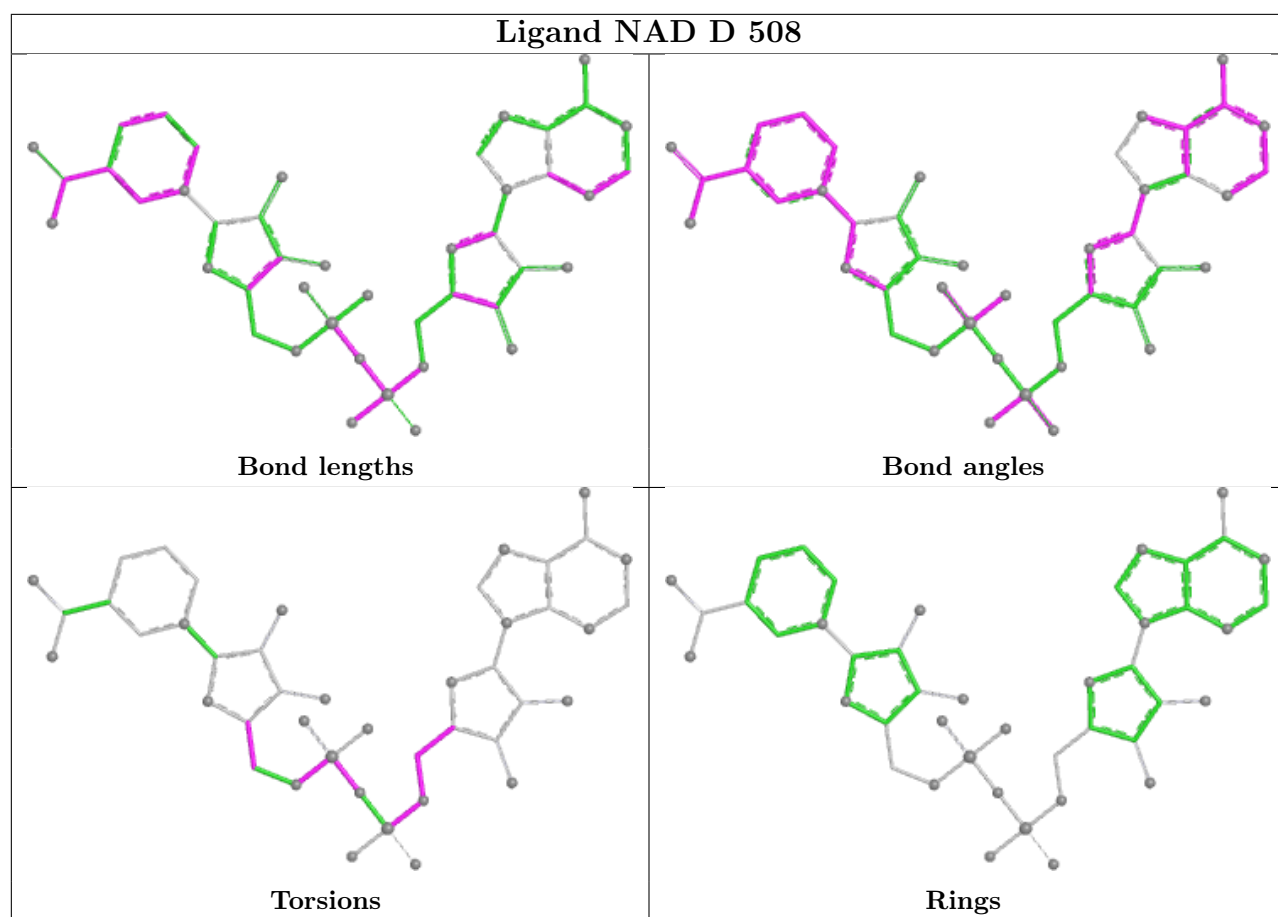


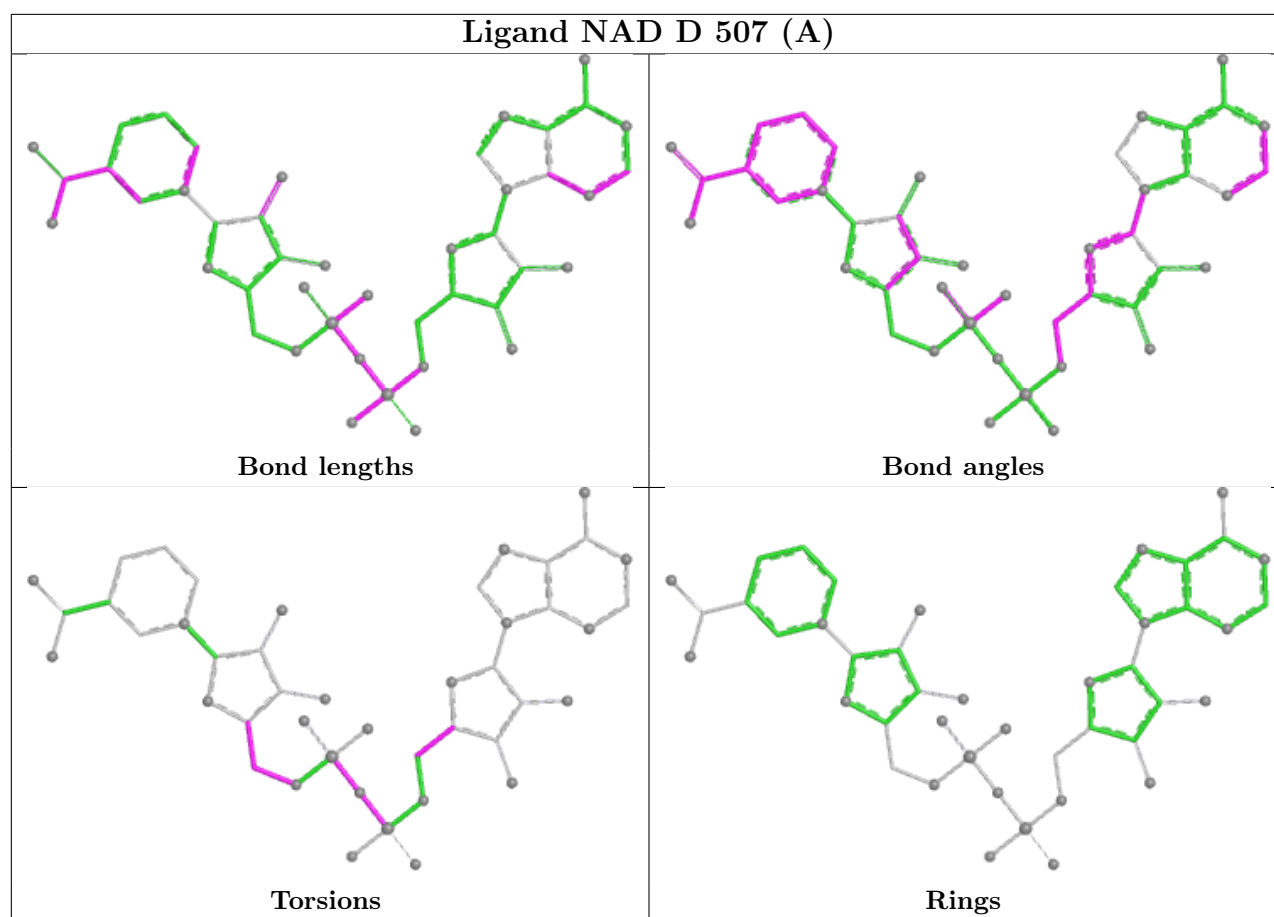
## Ligand NAD F 508 (A)

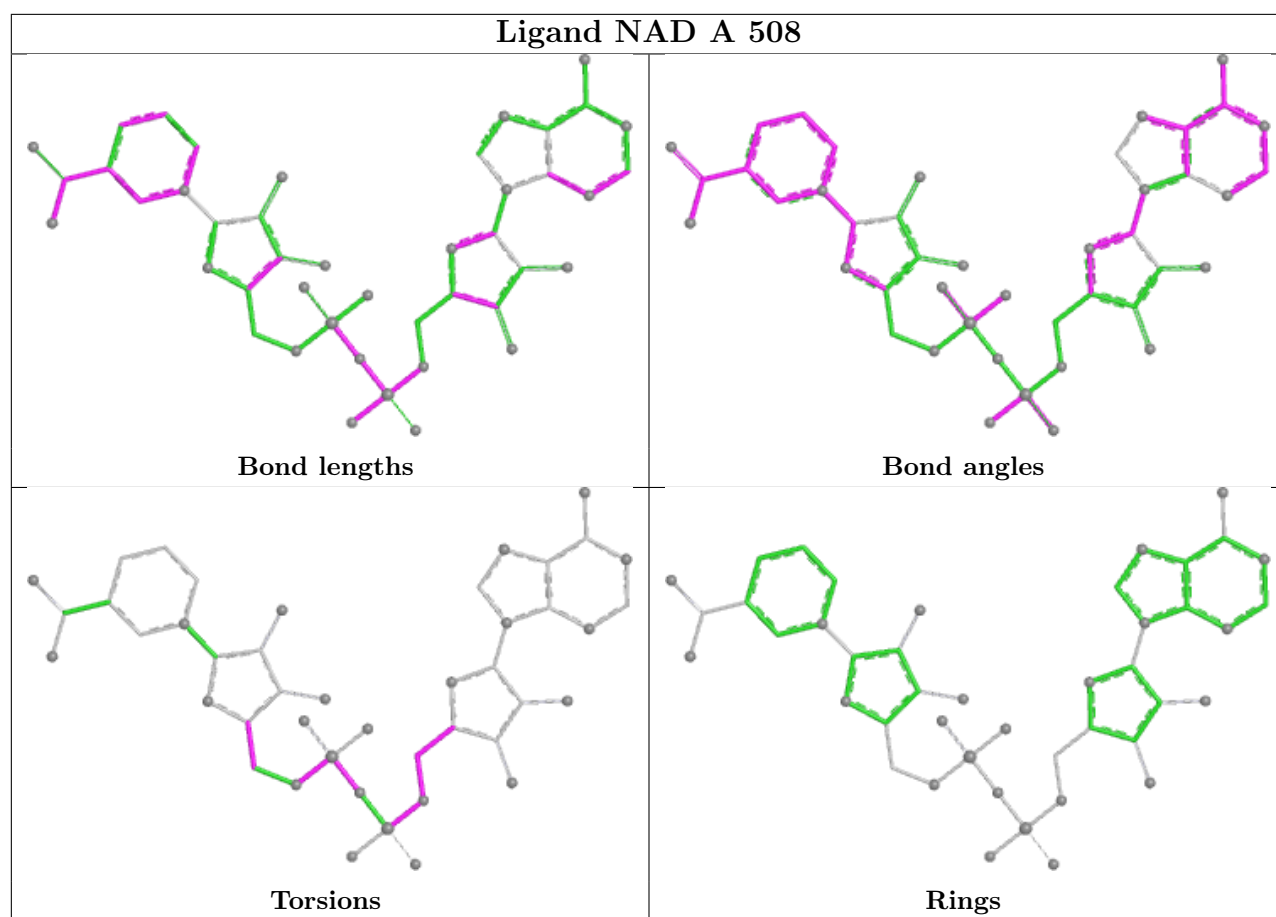


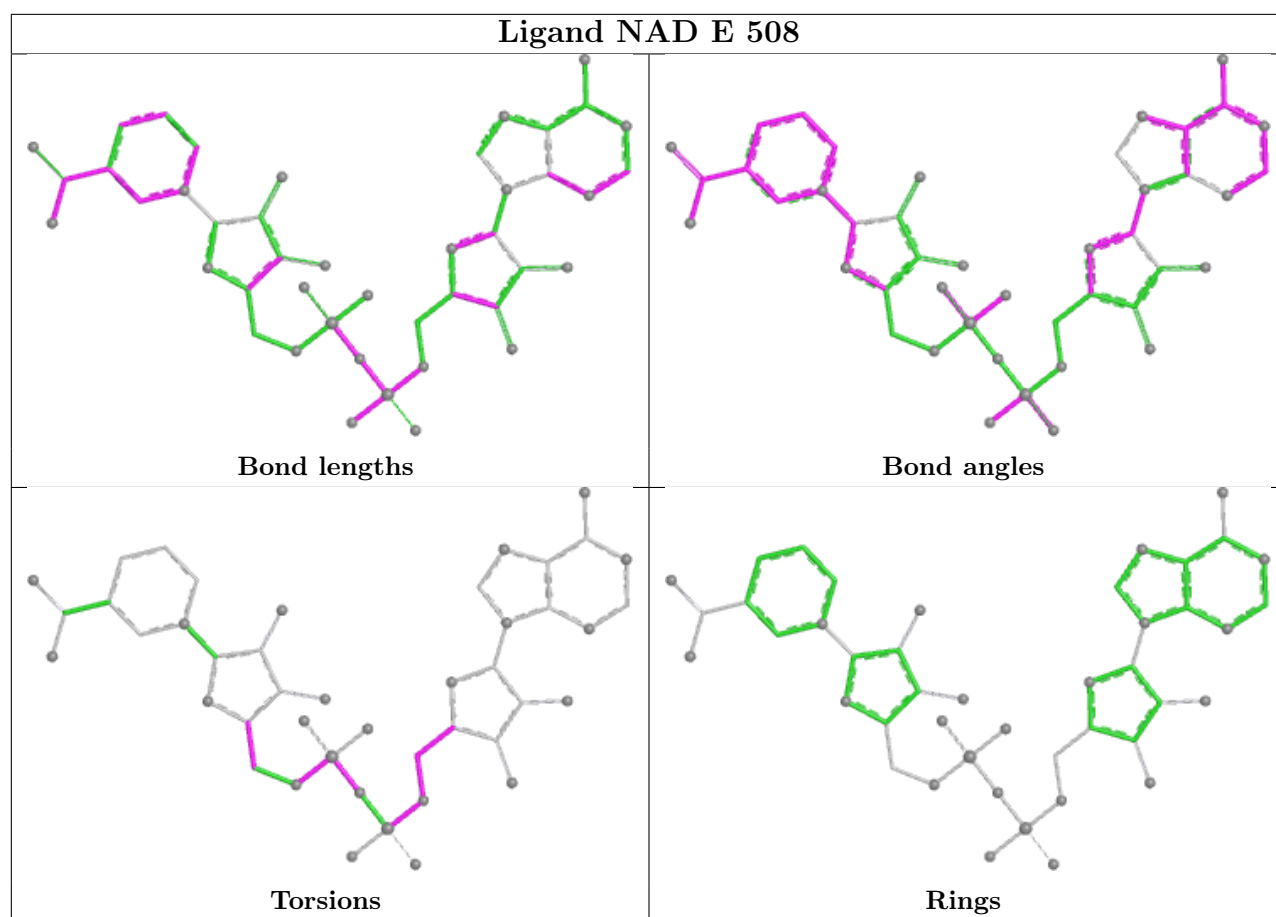
## Ligand NAD A 507 (B)





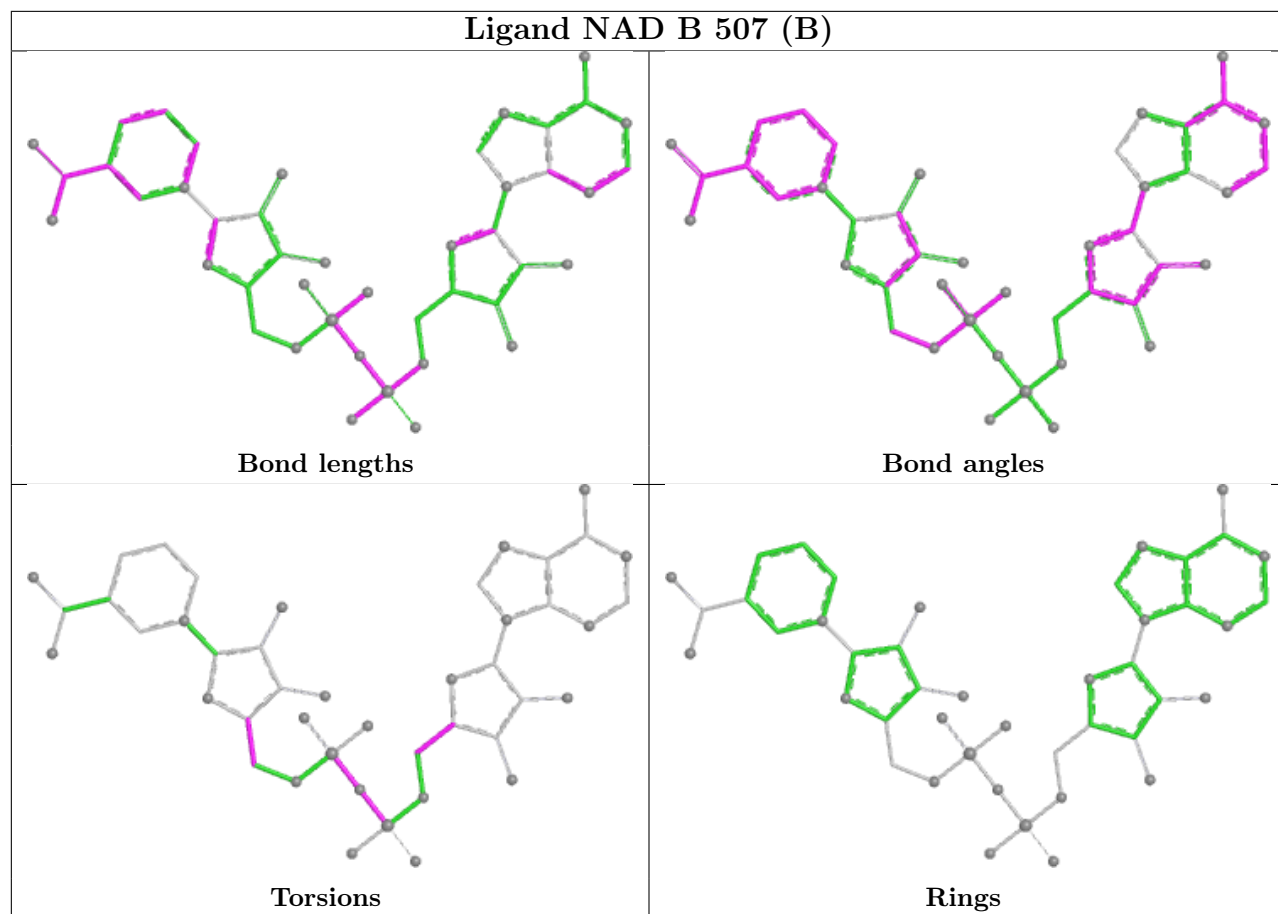




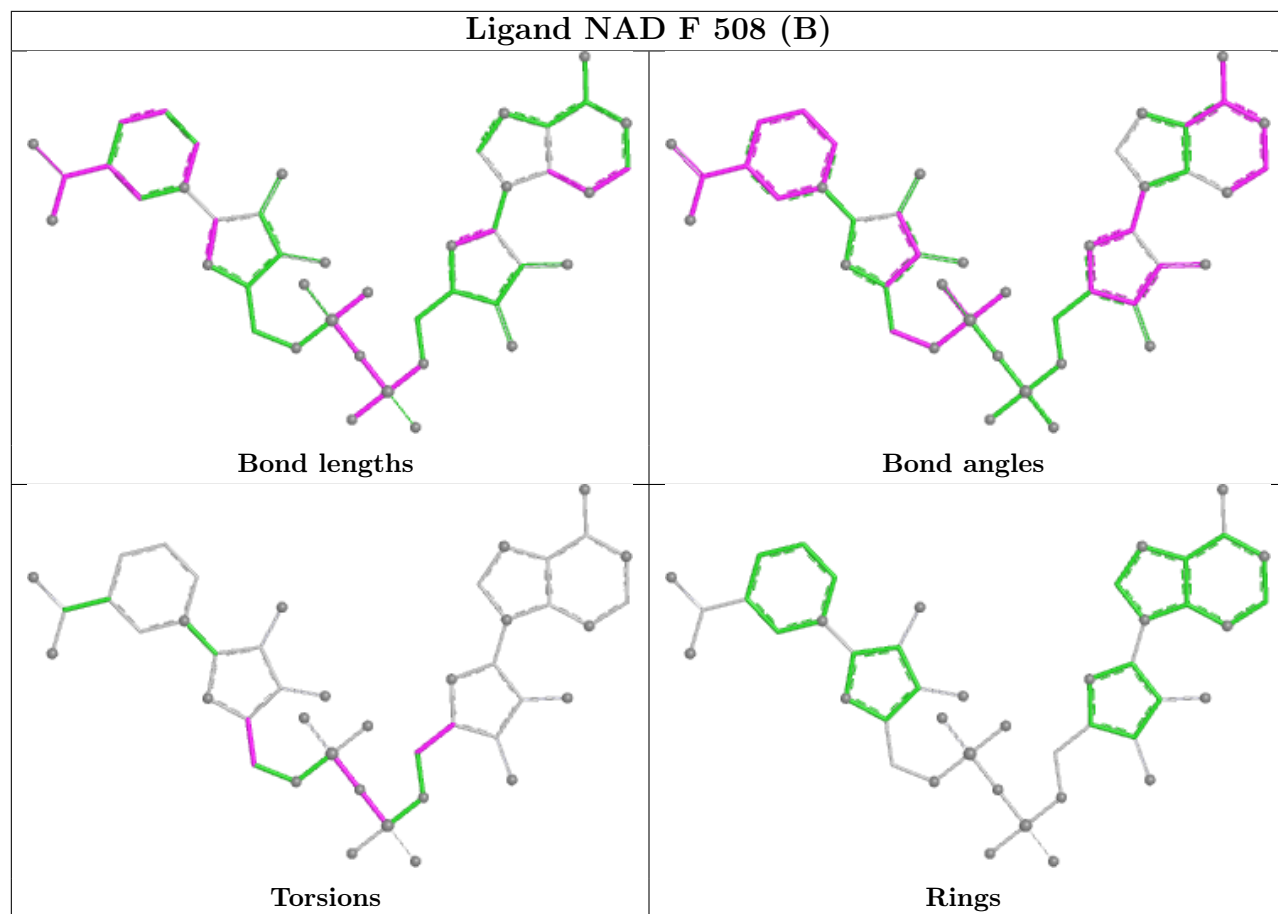


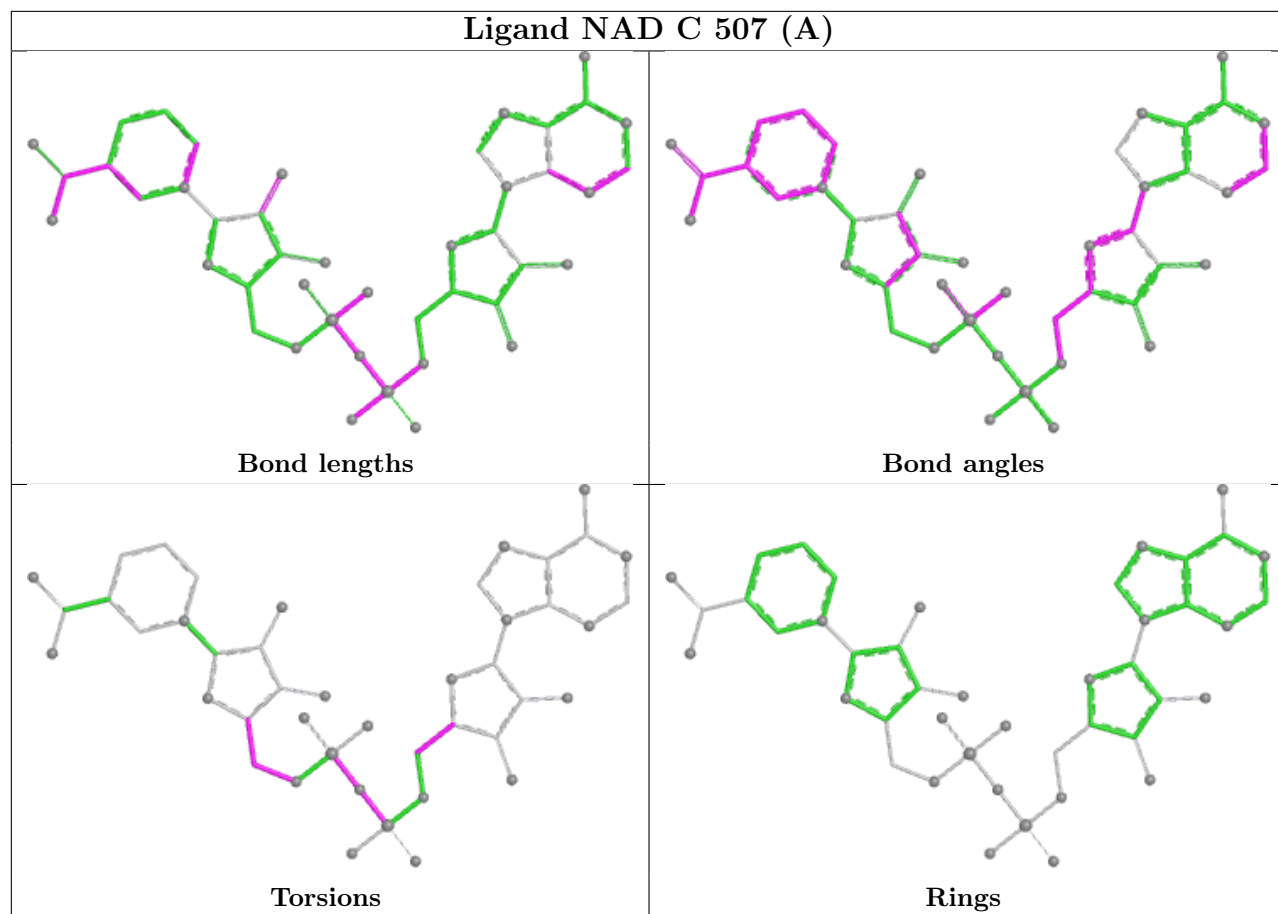


## Ligand NAD B 507 (B)

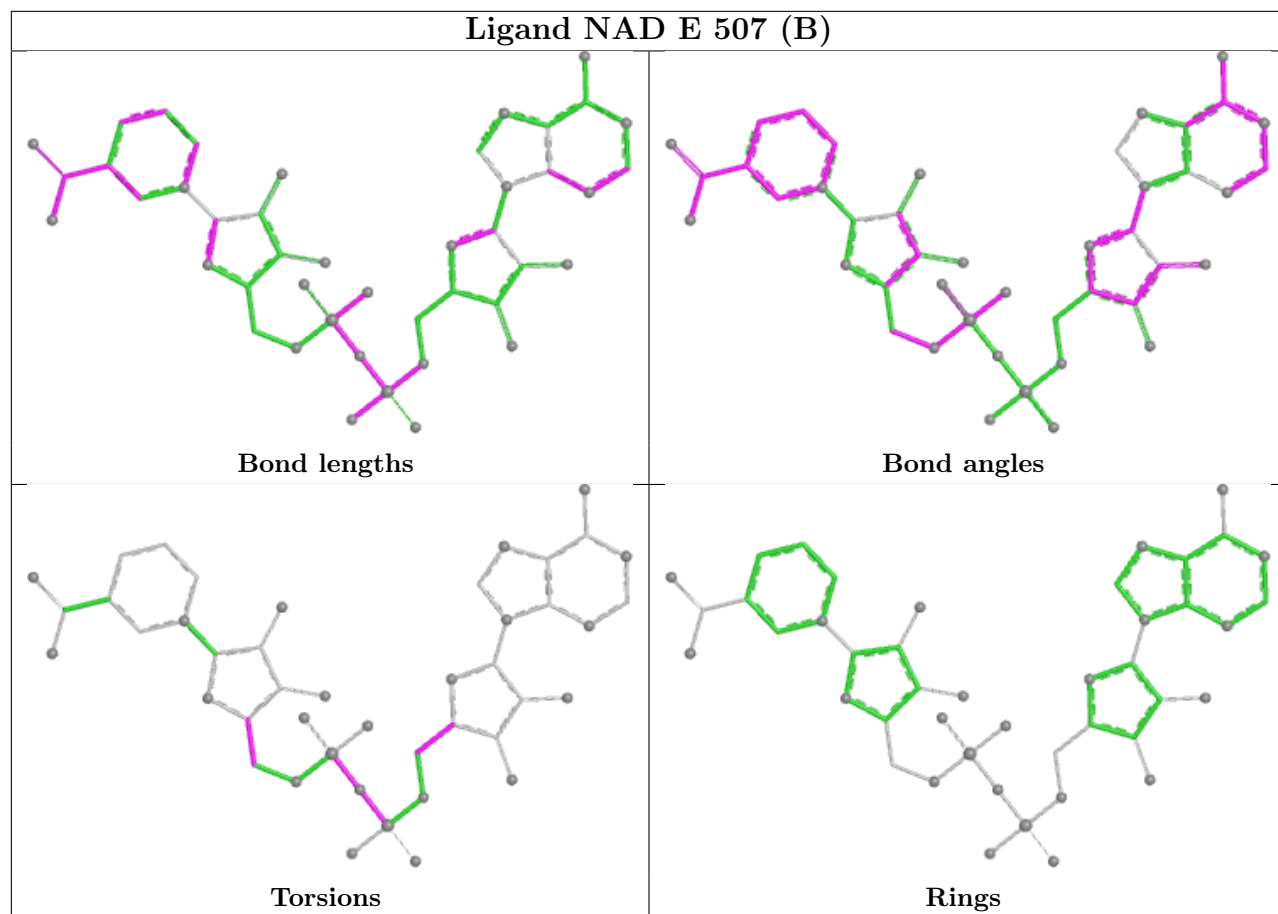


## Ligand NAD F 508 (B)

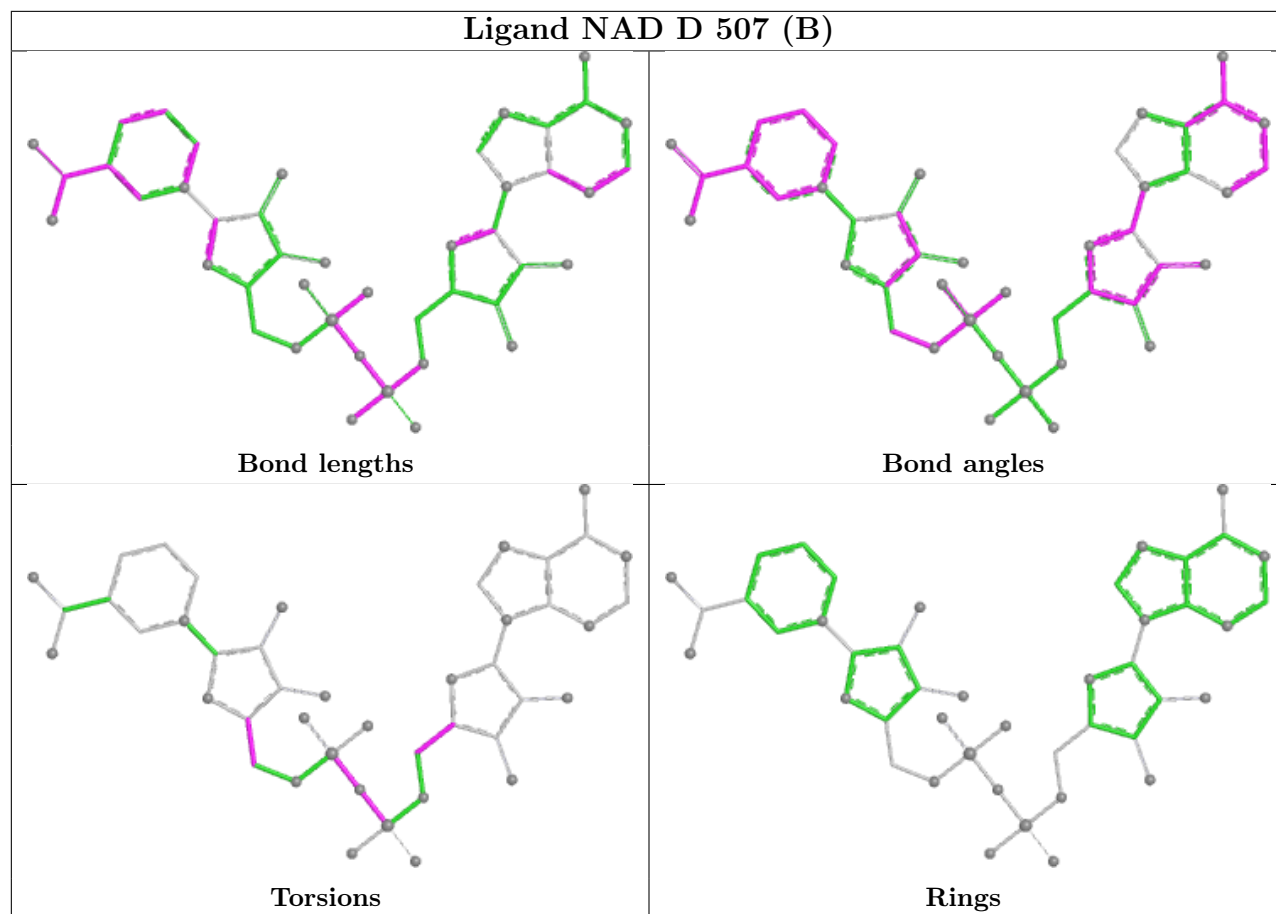




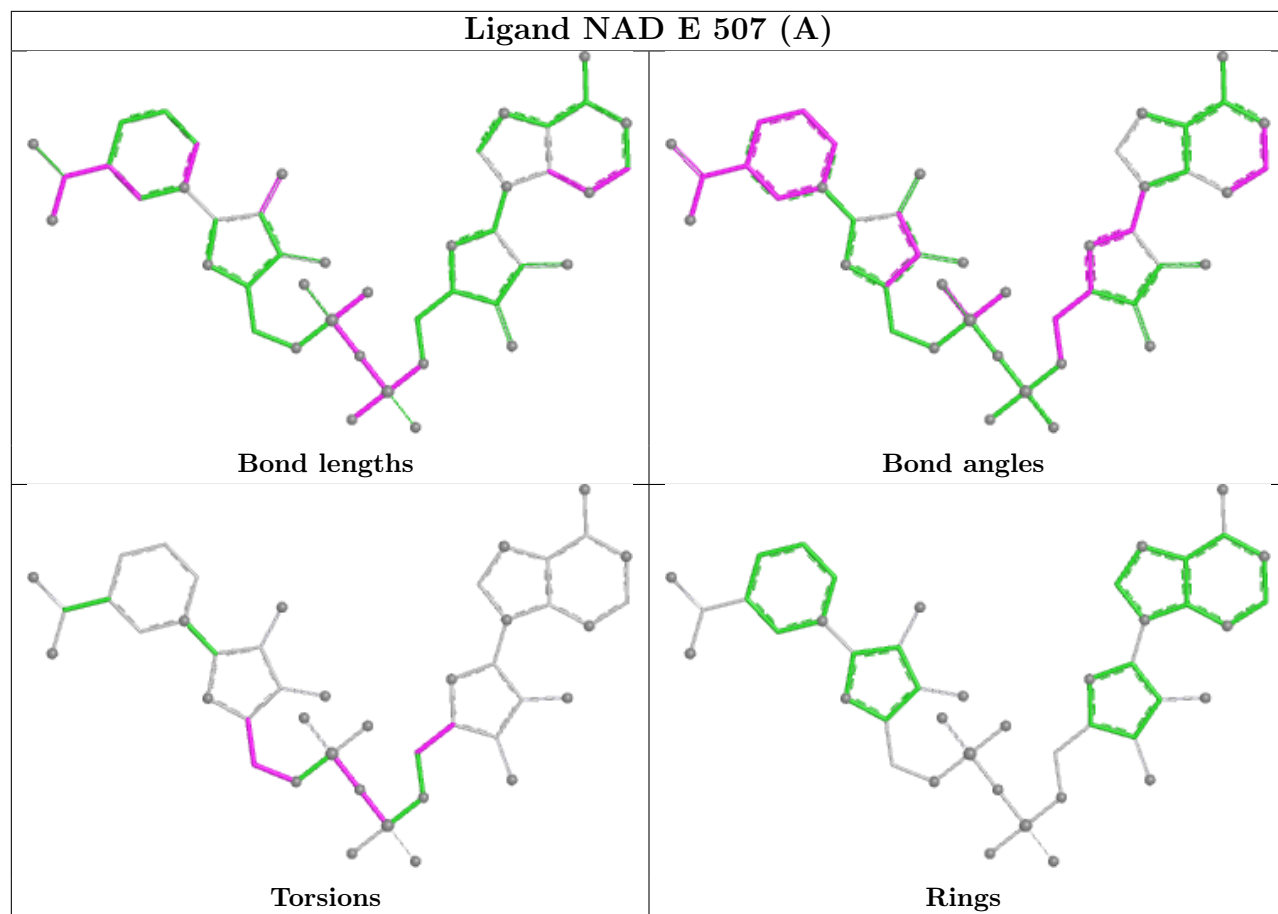
## Ligand NAD E 507 (B)

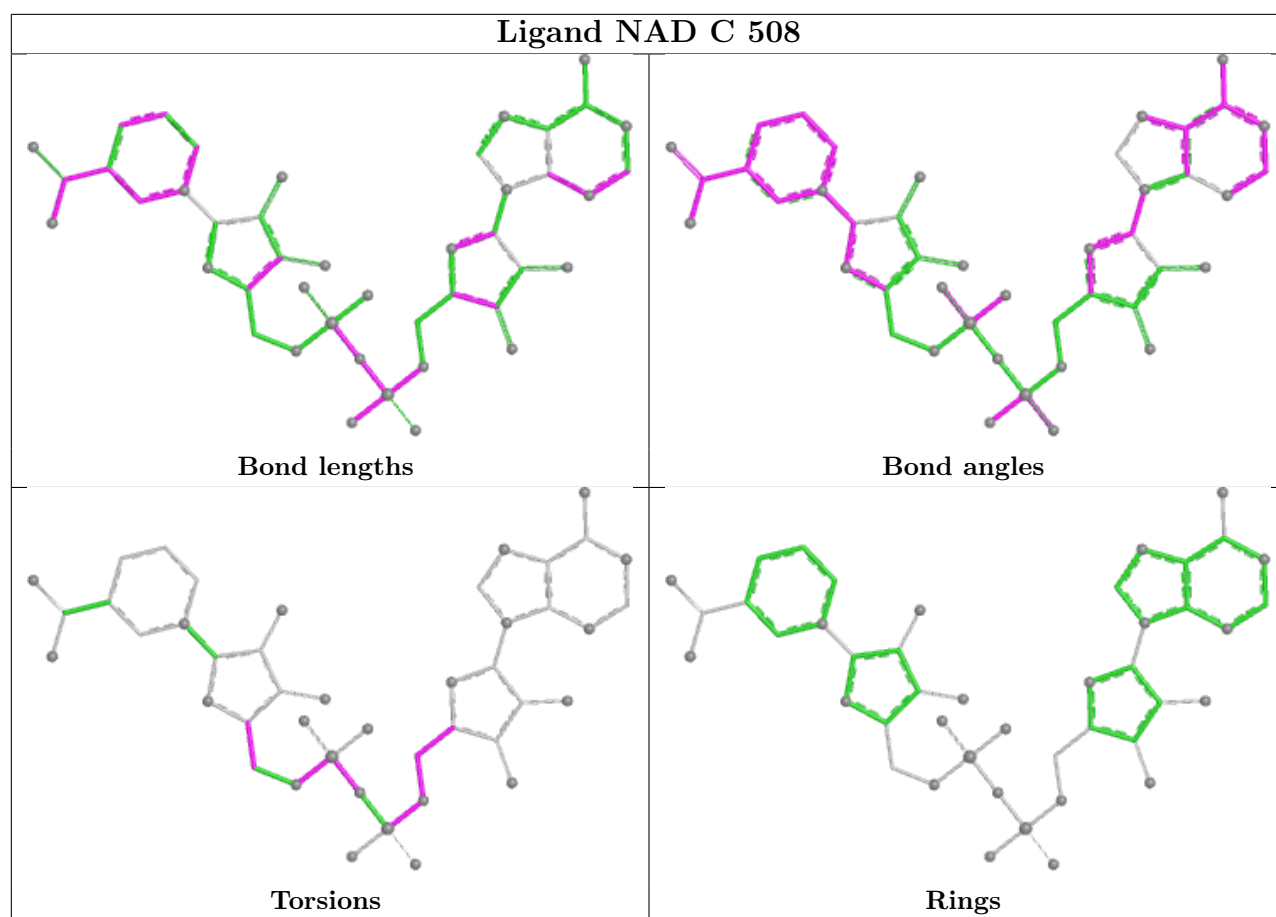


## Ligand NAD D 507 (B)

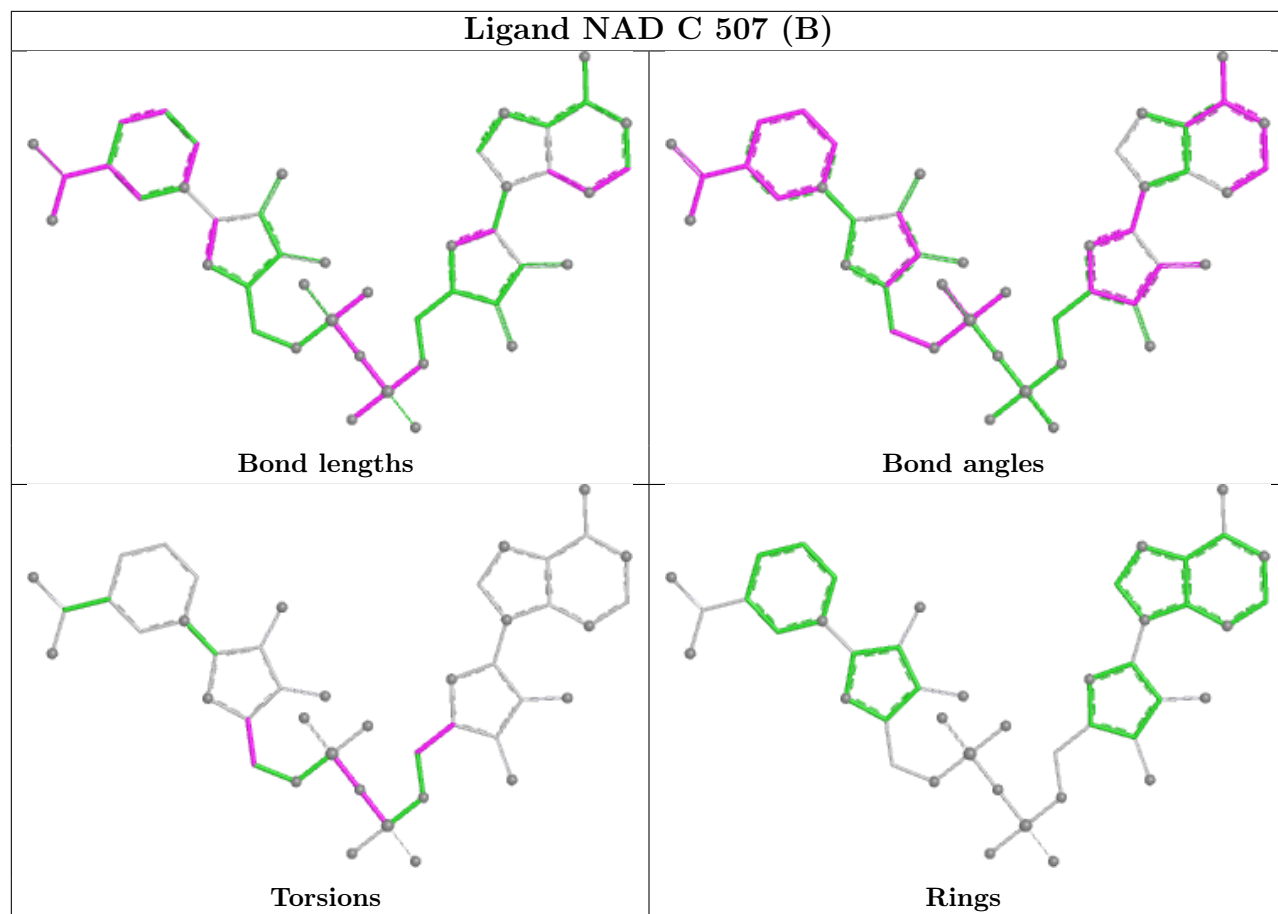


## Ligand NAD E 507 (A)

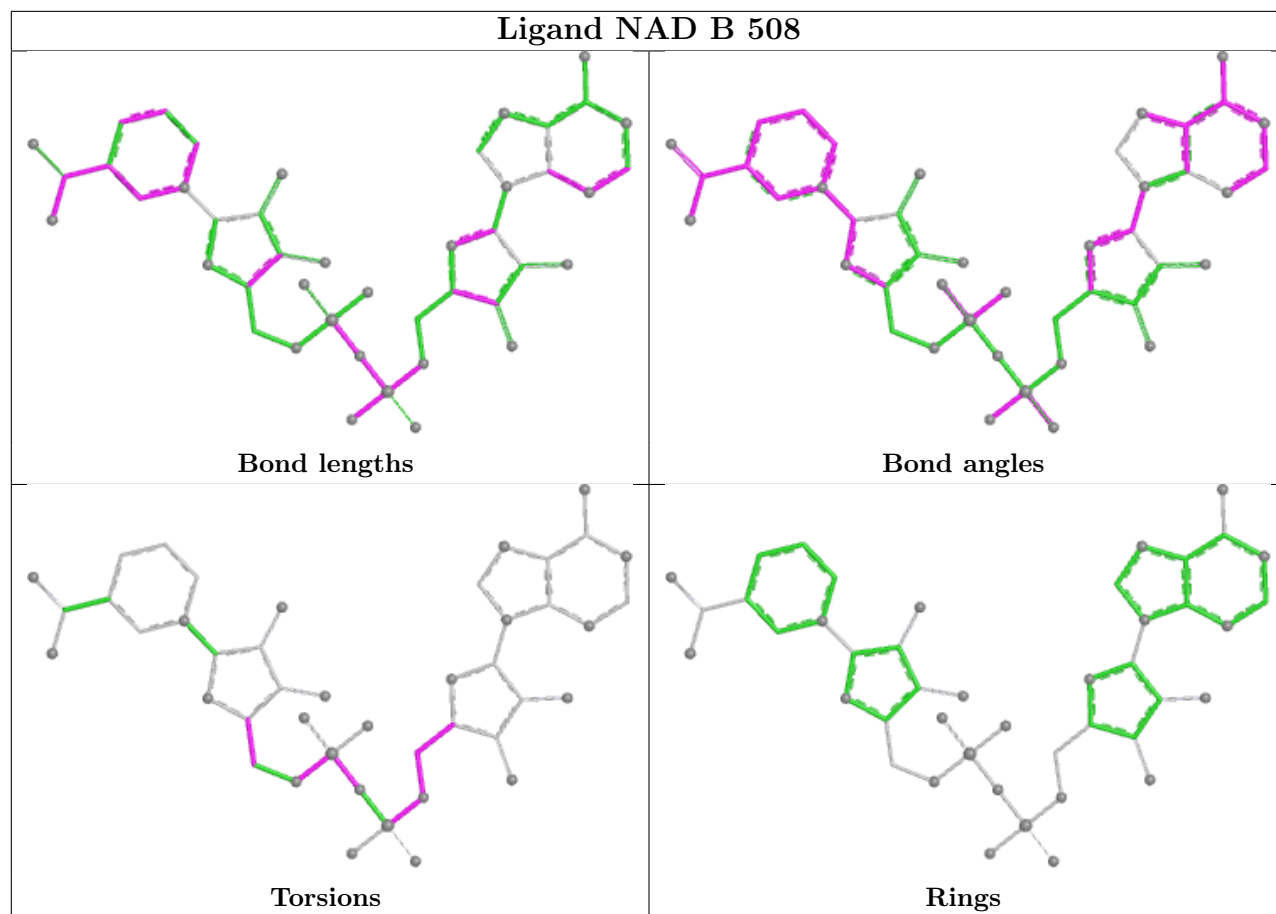




## Ligand NAD C 507 (B)







## 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](#)

EDS was not executed - this section is therefore empty.

### 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

### 6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

### 6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.