



# wwPDB X-ray Structure Validation Summary Report

Aug 20, 2023 – 09:13 AM EDT

PDB ID : 2O1D  
Title : Crystal structure of IRAK4 kinase domain complexed with AMPPNP  
Authors : Kuglstatter, A.; Villasenor, A.G.; Browner, M.F.  
Deposited on : 2007-01-10  
Resolution : 2.30 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

<https://www.wwpdb.org/validation/2017/FAQs#types>.

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The following versions of software and data (see [references](#) ) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtrriage (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) : 2.35

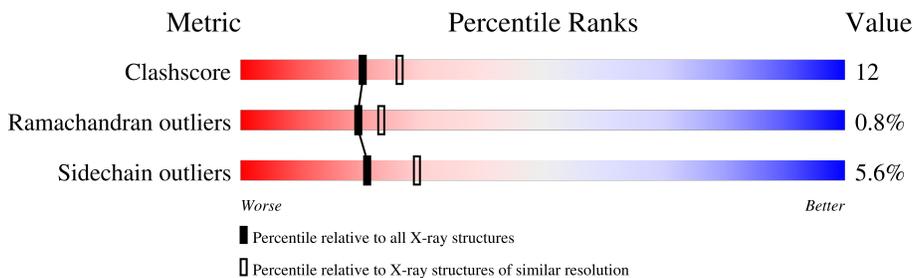
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	301	
1	B	301	
1	C	301	
1	D	301	

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 8921 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.

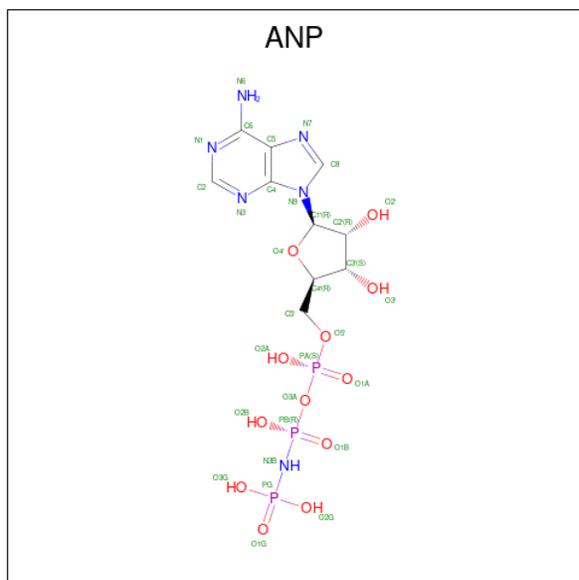
- Molecule 1 is a protein called Interleukin-1 receptor-associated kinase 4.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	266	2105	1321	356	412	3	13	0	0	0
1	B	274	2171	1364	368	424	2	13	0	0	0
1	C	259	2052	1286	344	405	3	14	0	0	0
1	D	277	2190	1370	369	434	3	14	0	0	0

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	342	TPO	THR	modified residue	UNP Q9NWZ3
A	345	TPO	THR	modified residue	UNP Q9NWZ3
A	346	SEP	SER	modified residue	UNP Q9NWZ3
B	342	TPO	THR	modified residue	UNP Q9NWZ3
B	345	TPO	THR	modified residue	UNP Q9NWZ3
B	346	SEP	SER	modified residue	UNP Q9NWZ3
C	342	TPO	THR	modified residue	UNP Q9NWZ3
C	345	TPO	THR	modified residue	UNP Q9NWZ3
C	346	SEP	SER	modified residue	UNP Q9NWZ3
D	342	TPO	THR	modified residue	UNP Q9NWZ3
D	345	TPO	THR	modified residue	UNP Q9NWZ3
D	346	SEP	SER	modified residue	UNP Q9NWZ3

- Molecule 2 is PHOSPHOAMINOPHOSPHONIC ACID-ADENYLATE ESTER (three-letter code: ANP) (formula:  $C_{10}H_{17}N_6O_{12}P_3$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	31	10	6	12	3	0	0
2	B	1	31	10	6	12	3	0	0
2	C	1	31	10	6	12	3	0	0
2	D	1	31	10	6	12	3	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	89	Total	O	0	0
			89	89		
3	B	83	Total	O	0	0
			83	83		
3	C	56	Total	O	0	0
			56	56		
3	D	51	Total	O	0	0
			51	51		

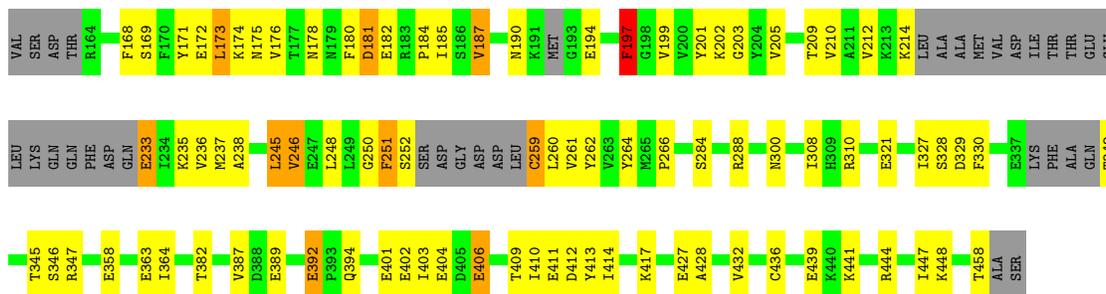
### 3 Residue-property plots [i](#)

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. 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.

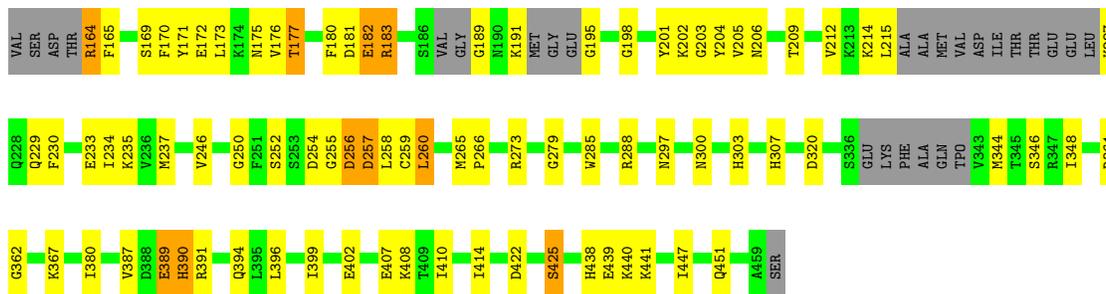
- Molecule 1: Interleukin-1 receptor-associated kinase 4

Chain A: 



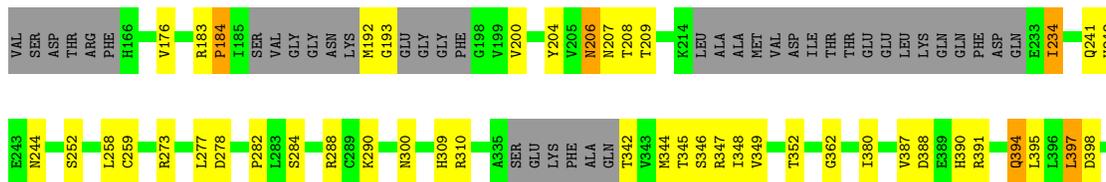
- Molecule 1: Interleukin-1 receptor-associated kinase 4

Chain B: 



- Molecule 1: Interleukin-1 receptor-associated kinase 4

Chain C: 





- Molecule 1: Interleukin-1 receptor-associated kinase 4

Chain D: 72% 18% 8%



## 4 Data and refinement statistics

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

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	147.12Å 138.97Å 89.20Å 90.00° 126.43° 90.00°	Depositor
Resolution (Å)	49.94 – 2.30	Depositor
% Data completeness (in resolution range)	99.3 (49.94-2.30)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.11	Depositor
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.241 , 0.295	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	8921	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	53.0	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: TPO, ANP, SEP

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	0/2106	0.66	0/2833
1	B	0.61	0/2184	0.66	0/2938
1	C	0.53	0/2051	0.62	1/2762 (0.0%)
1	D	0.54	1/2191 (0.0%)	0.60	0/2948
All	All	0.58	1/8532 (0.0%)	0.64	1/11481 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	276	CYS	CB-SG	-5.02	1.73	1.81

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	397	LEU	CA-CB-CG	6.21	129.59	115.30

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	2105	0	2077	73	2
1	B	2171	0	2138	73	3

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	2052	0	2024	36	0
1	D	2190	0	2148	34	1
2	A	31	0	13	1	0
2	B	31	0	13	0	0
2	C	31	0	13	4	0
2	D	31	0	13	3	0
3	A	89	0	0	7	0
3	B	83	0	0	2	1
3	C	56	0	0	1	0
3	D	51	0	0	2	0
All	All	8921	0	8439	213	4

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 12.

The worst 5 of 213 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:170:PHE:HA	1:B:173:LEU:HD12	1.34	1.09
1:B:233:GLU:O	1:B:237:MET:HG2	1.59	1.02
1:B:265:MET:HE1	1:B:320:ASP:HB3	1.41	1.02
1:D:195:GLY:HA3	2:D:4:ANP:O2G	1.70	0.92
1:A:169:SER:O	1:A:172:GLU:HG2	1.74	0.87

All (4) 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)
3:B:2108:HOH:O	3:B:2108:HOH:O[2_555]	1.85	0.35
1:A:175:ASN:ND2	1:B:176:VAL:CG1[2_555]	1.89	0.31
1:A:176:VAL:CG1	1:B:175:ASN:ND2[2_555]	2.15	0.05
1:B:361:ARG:NH1	1:D:355:MET:O[4_546]	2.17	0.03

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries

of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	254/301 (84%)	242 (95%)	9 (4%)	3 (1%)	13	14
1	B	262/301 (87%)	245 (94%)	15 (6%)	2 (1%)	19	23
1	C	247/301 (82%)	228 (92%)	17 (7%)	2 (1%)	19	23
1	D	266/301 (88%)	255 (96%)	10 (4%)	1 (0%)	34	42
All	All	1029/1204 (86%)	970 (94%)	51 (5%)	8 (1%)	19	23

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	406	GLU
1	A	197	PHE
1	B	257	ASP
1	C	207	ASN
1	B	390	HIS

### 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	229/259 (88%)	216 (94%)	13 (6%)	20	28
1	B	238/259 (92%)	225 (94%)	13 (6%)	21	30
1	C	225/259 (87%)	213 (95%)	12 (5%)	22	31
1	D	239/259 (92%)	225 (94%)	14 (6%)	19	27
All	All	931/1036 (90%)	879 (94%)	52 (6%)	21	29

5 of 52 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	234	ILE
1	C	394	GLN

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Mol	Chain	Res	Type
1	D	343	VAL
1	C	241	GLN
1	C	344	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 17 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	175	ASN
1	D	232	GLN
1	B	206	ASN
1	B	394	GLN
1	C	166	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](#)

11 non-standard protein/DNA/RNA residues 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
1	TPO	A	342	1	8,10,11	0.78	0	10,14,16	1.00	1 (10%)
1	SEP	A	346	1	8,9,10	1.61	1 (12%)	8,12,14	1.44	2 (25%)
1	TPO	C	345	1	8,10,11	0.86	0	10,14,16	0.87	0
1	TPO	D	345	1	8,10,11	0.81	0	10,14,16	1.05	0
1	SEP	B	346	1	8,9,10	1.61	1 (12%)	8,12,14	1.10	0
1	TPO	C	342	1	8,10,11	0.82	0	10,14,16	1.06	1 (10%)
1	TPO	A	345	1	8,10,11	0.96	0	10,14,16	0.82	0
1	SEP	D	346	1	8,9,10	1.59	1 (12%)	8,12,14	1.78	2 (25%)
1	TPO	B	345	1	8,10,11	0.90	0	10,14,16	0.98	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
1	SEP	C	346	1	8,9,10	1.57	1 (12%)	8,12,14	1.64	2 (25%)
1	TPO	D	342	1	8,10,11	0.77	0	10,14,16	1.01	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
1	TPO	A	342	1	-	1/9/11/13	-
1	SEP	A	346	1	-	1/5/8/10	-
1	TPO	C	345	1	-	3/9/11/13	-
1	TPO	D	345	1	-	3/9/11/13	-
1	SEP	B	346	1	-	4/5/8/10	-
1	TPO	C	342	1	-	2/9/11/13	-
1	TPO	A	345	1	-	3/9/11/13	-
1	SEP	D	346	1	-	1/5/8/10	-
1	TPO	B	345	1	-	5/9/11/13	-
1	SEP	C	346	1	-	3/5/8/10	-
1	TPO	D	342	1	-	0/9/11/13	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	346	SEP	P-O1P	3.53	1.61	1.50
1	A	346	SEP	P-O1P	3.48	1.61	1.50
1	B	346	SEP	P-O1P	3.47	1.61	1.50
1	C	346	SEP	P-O1P	3.39	1.61	1.50

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	346	SEP	OG-CB-CA	3.60	111.65	108.14
1	C	346	SEP	OG-CB-CA	3.46	111.52	108.14
1	D	346	SEP	P-OG-CB	-2.74	110.75	118.30
1	A	346	SEP	OG-CB-CA	2.51	110.58	108.14
1	C	346	SEP	P-OG-CB	-2.41	111.67	118.30

There are no chirality outliers.

5 of 26 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	345	TPO	N-CA-CB-OG1
1	A	345	TPO	O-C-CA-CB
1	B	345	TPO	N-CA-CB-OG1
1	B	345	TPO	CB-OG1-P-O1P
1	B	346	SEP	N-CA-CB-OG

There are no ring outliers.

3 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	C	345	TPO	1	0
1	A	345	TPO	1	0
1	D	342	TPO	2	0

## 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

4 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	ANP	A	1	-	29,33,33	1.97	8 (27%)	31,52,52	1.79	6 (19%)
2	ANP	C	3	-	29,33,33	1.97	6 (20%)	31,52,52	1.76	7 (22%)
2	ANP	D	4	-	29,33,33	1.96	7 (24%)	31,52,52	1.48	5 (16%)
2	ANP	B	2	-	29,33,33	1.98	7 (24%)	31,52,52	1.64	8 (25%)

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	ANP	A	1	-	-	1/14/38/38	0/3/3/3
2	ANP	C	3	-	-	6/14/38/38	0/3/3/3
2	ANP	D	4	-	-	8/14/38/38	0/3/3/3
2	ANP	B	2	-	-	3/14/38/38	0/3/3/3

The worst 5 of 28 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	4	ANP	PB-N3B	4.99	1.76	1.63
2	A	1	ANP	PG-N3B	4.91	1.76	1.63
2	B	2	ANP	PG-N3B	4.78	1.75	1.63
2	C	3	ANP	PG-N3B	4.75	1.75	1.63
2	D	4	ANP	PG-N3B	4.73	1.75	1.63

The worst 5 of 26 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	3	ANP	O1G-PG-N3B	-4.69	104.87	111.77
2	A	1	ANP	O1G-PG-N3B	-4.66	104.91	111.77
2	A	1	ANP	O2B-PB-O1B	4.29	118.91	109.92
2	A	1	ANP	N3-C2-N1	-4.05	122.35	128.68
2	B	2	ANP	N3-C2-N1	-3.96	122.49	128.68

There are no chirality outliers.

5 of 18 torsion outliers are listed below:

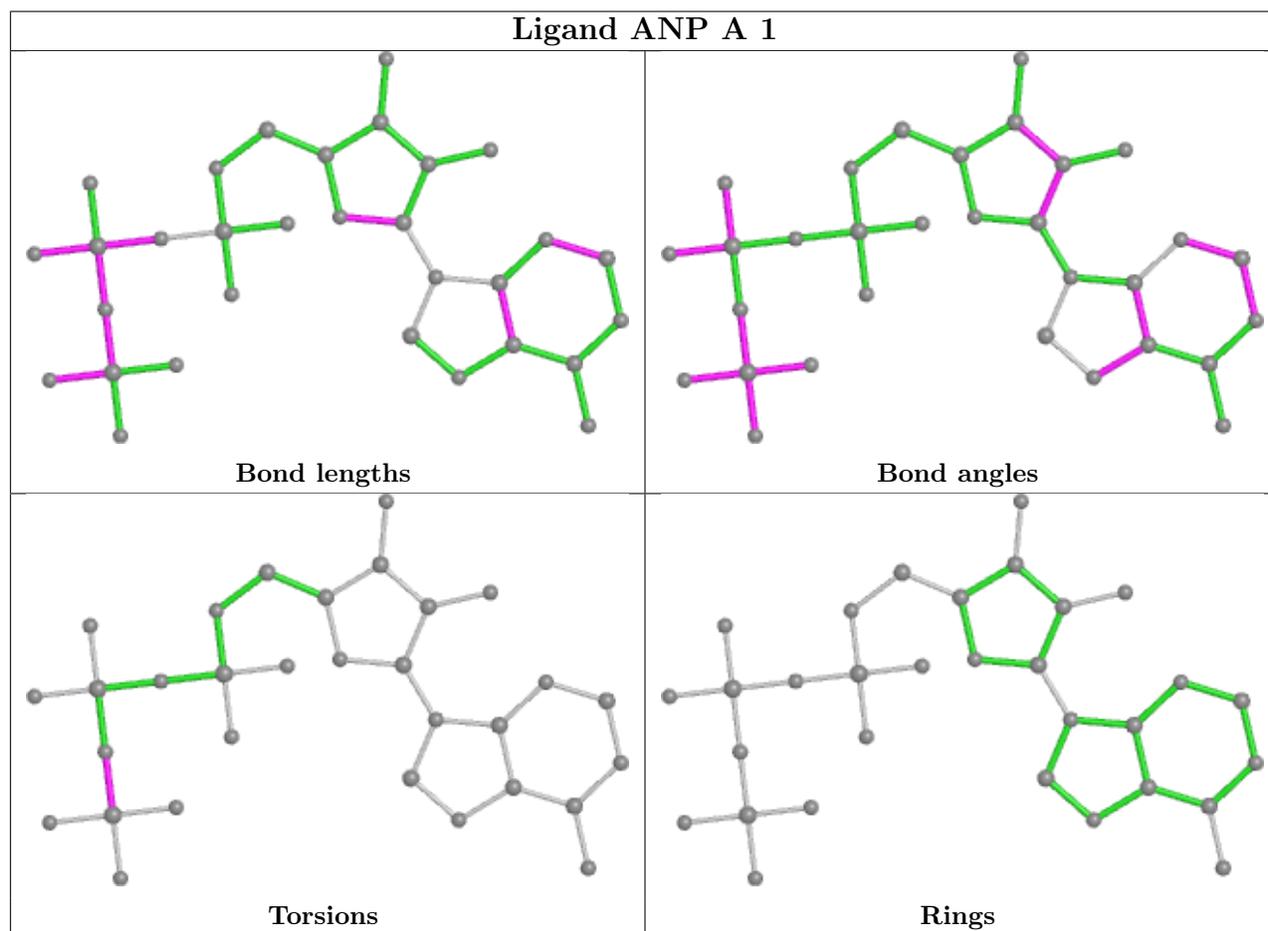
Mol	Chain	Res	Type	Atoms
2	A	1	ANP	PB-N3B-PG-O1G
2	B	2	ANP	PB-N3B-PG-O1G
2	C	3	ANP	PB-N3B-PG-O1G
2	D	4	ANP	PB-N3B-PG-O1G
2	D	4	ANP	PG-N3B-PB-O1B

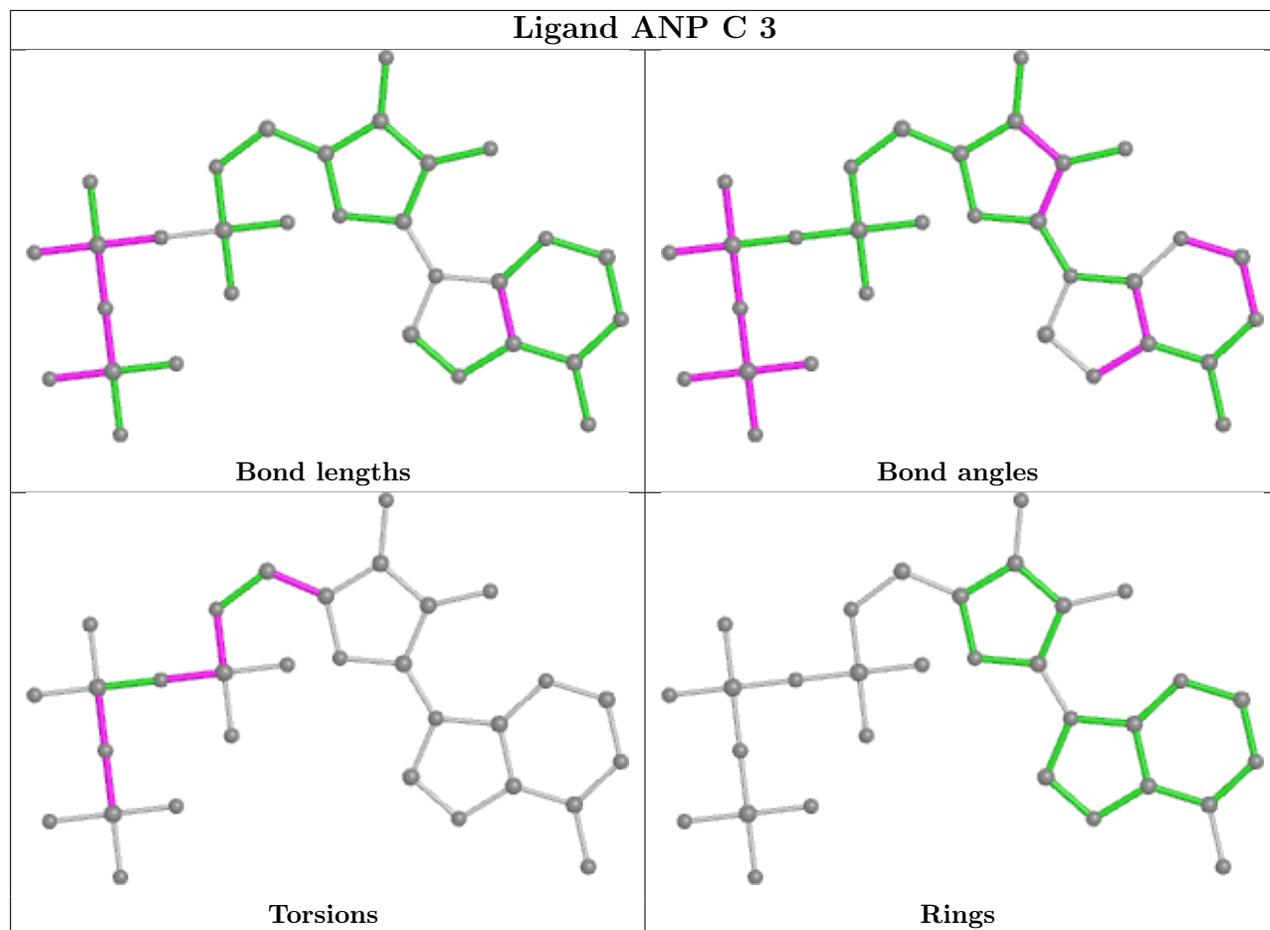
There are no ring outliers.

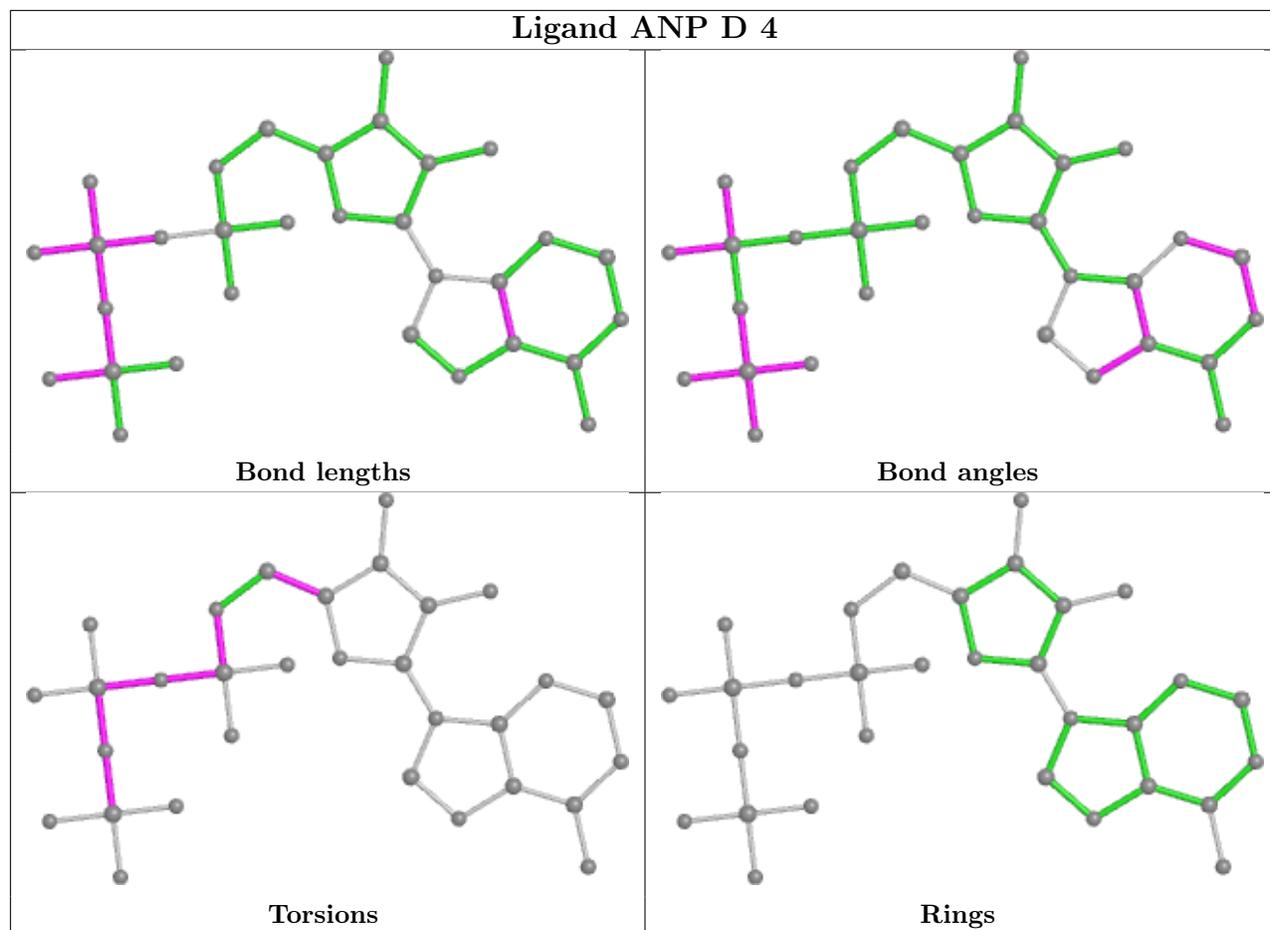
3 monomers are involved in 8 short contacts:

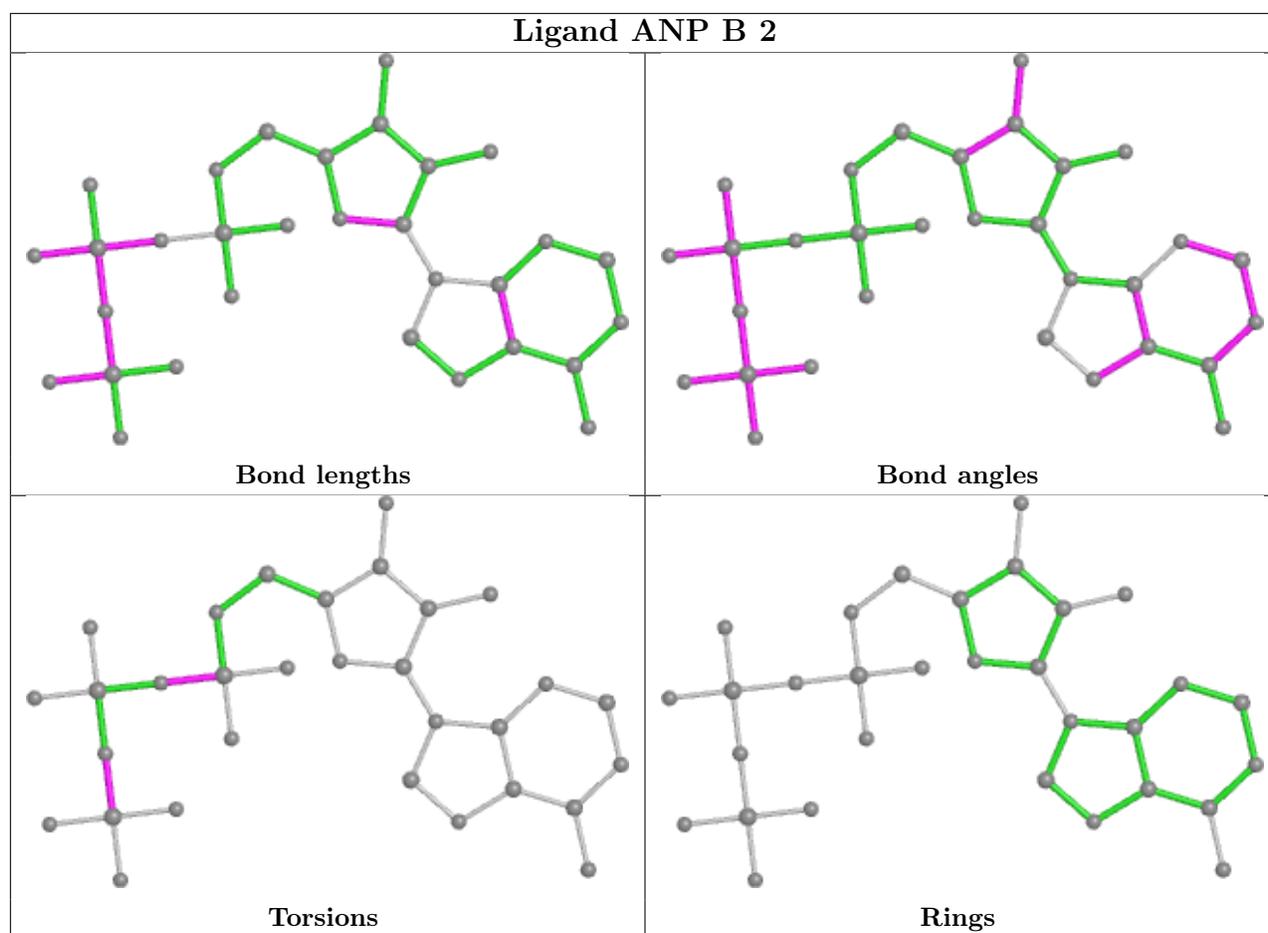
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1	ANP	1	0
2	C	3	ANP	4	0
2	D	4	ANP	3	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.









## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

## 6 Fit of model and data [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.