



# Full wwPDB X-ray Structure Validation Report ⓘ

Oct 1, 2021 – 01:06 am BST

PDB ID : 7NF2  
Title : Structure of T. atroviride Fdc variant TaFdcV in complex with prFMN crotonic acid adduct  
Authors : Saaret, A.; Leys, D.  
Deposited on : 2021-02-05  
Resolution : 1.33 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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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) : 2.23.2

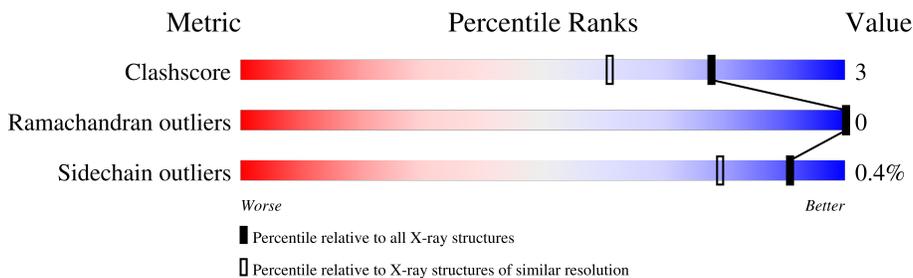
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.33 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	1417 (1.36-1.32)
Ramachandran outliers	138981	1397 (1.36-1.32)
Sidechain outliers	138945	1397 (1.36-1.32)

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	519	
1	B	519	

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 criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	ACT	A	1203	-	-	X	-
2	ACT	B	901	-	-	X	-
2	ACT	B	902	-	-	X	-

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 8989 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 Ferulic acid decarboxylase 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	497	3925	2493	679	731	22	0	12	0
1	B	496	3901	2478	674	728	21	0	10	0

There are 36 discrepancies between the modelled and reference sequences:

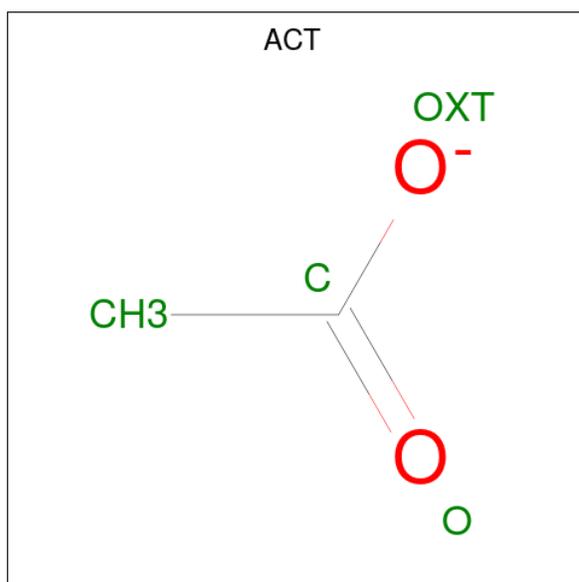
Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	MET	-	initiating methionine	UNP G9NLP8
A	-5	HIS	-	expression tag	UNP G9NLP8
A	-4	HIS	-	expression tag	UNP G9NLP8
A	-3	HIS	-	expression tag	UNP G9NLP8
A	-2	HIS	-	expression tag	UNP G9NLP8
A	-1	HIS	-	expression tag	UNP G9NLP8
A	0	HIS	-	expression tag	UNP G9NLP8
A	25	ASN	GLU	engineered mutation	UNP G9NLP8
A	31	GLY	ASN	engineered mutation	UNP G9NLP8
A	305	ALA	GLY	engineered mutation	UNP G9NLP8
A	351	ARG	ASP	engineered mutation	UNP G9NLP8
A	377	HIS	LYS	engineered mutation	UNP G9NLP8
A	402	VAL	PRO	engineered mutation	UNP G9NLP8
A	404	TYR	PHE	engineered mutation	UNP G9NLP8
A	405	MET	THR	engineered mutation	UNP G9NLP8
A	429	ALA	THR	engineered mutation	UNP G9NLP8
A	445	PRO	VAL	engineered mutation	UNP G9NLP8
A	448	TRP	GLN	engineered mutation	UNP G9NLP8
B	-6	MET	-	initiating methionine	UNP G9NLP8
B	-5	HIS	-	expression tag	UNP G9NLP8
B	-4	HIS	-	expression tag	UNP G9NLP8
B	-3	HIS	-	expression tag	UNP G9NLP8
B	-2	HIS	-	expression tag	UNP G9NLP8
B	-1	HIS	-	expression tag	UNP G9NLP8
B	0	HIS	-	expression tag	UNP G9NLP8

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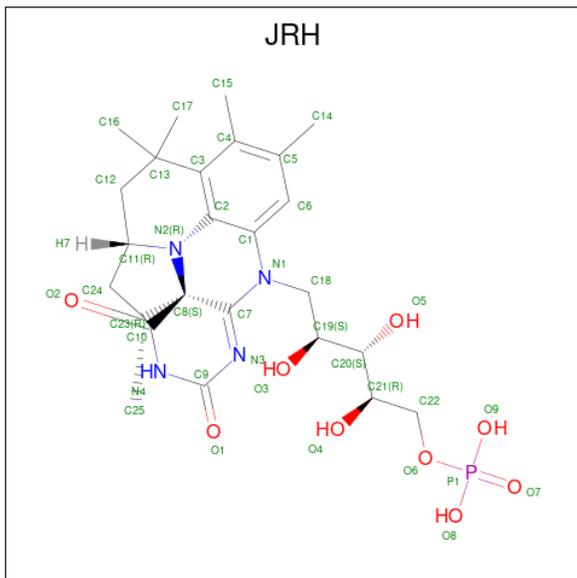
Chain	Residue	Modelled	Actual	Comment	Reference
B	25	ASN	GLU	engineered mutation	UNP G9NLP8
B	31	GLY	ASN	engineered mutation	UNP G9NLP8
B	305	ALA	GLY	engineered mutation	UNP G9NLP8
B	351	ARG	ASP	engineered mutation	UNP G9NLP8
B	377	HIS	LYS	engineered mutation	UNP G9NLP8
B	402	VAL	PRO	engineered mutation	UNP G9NLP8
B	404	TYR	PHE	engineered mutation	UNP G9NLP8
B	405	MET	THR	engineered mutation	UNP G9NLP8
B	429	ALA	THR	engineered mutation	UNP G9NLP8
B	445	PRO	VAL	engineered mutation	UNP G9NLP8
B	448	TRP	GLN	engineered mutation	UNP G9NLP8

- Molecule 2 is ACETATE ION (three-letter code: ACT) (formula:  $C_2H_3O_2$ ).



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

- Molecule 3 is prFMN cofactor and crotonic acid adduct (three-letter code: JRH) (formula:  $C_{25}H_{35}N_4O_9P$ ) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
3	A	1	Total	C	N	O	P	0	0
			39	25	4	9	1		
3	B	1	Total	C	N	O	P	0	0
			39	25	4	9	1		

- Molecule 4 is POTASSIUM ION (three-letter code: K) (formula: K).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	K		
4	A	2	Total	K	0	0
			2	2		
4	B	2	Total	K	0	0
			2	2		

- Molecule 5 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mn		
5	A	1	Total	Mn	0	0
			1	1		
5	B	1	Total	Mn	0	0
			1	1		

- Molecule 6 is water.

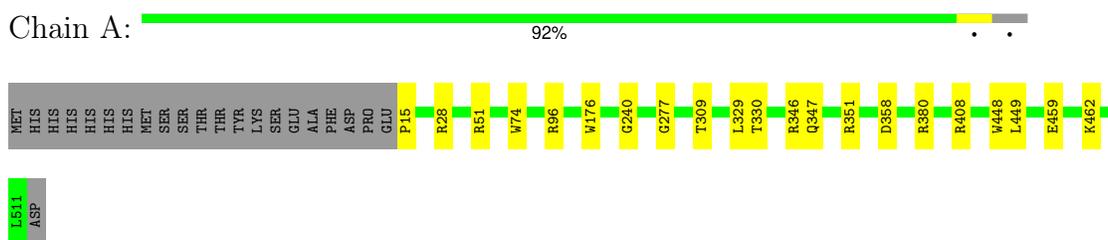
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	578	Total 578	O 578	0	0
6	B	477	Total 477	O 477	0	0

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

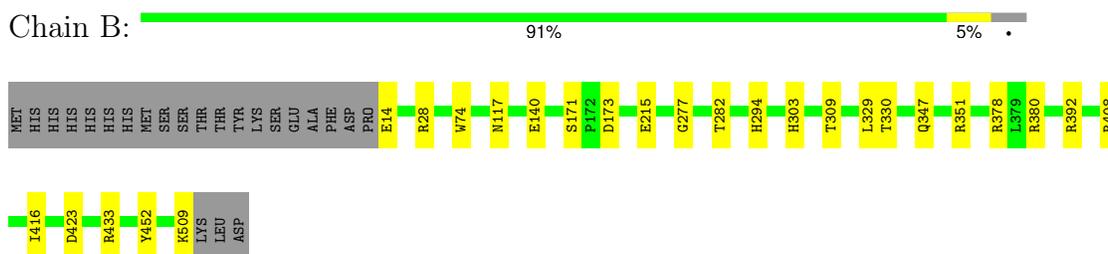
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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: Ferulic acid decarboxylase 1



- Molecule 1: Ferulic acid decarboxylase 1



## 4 Data and refinement statistics

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

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	74.54Å 74.54Å 345.36Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	115.12 – 1.33	Depositor
% Data completeness (in resolution range)	99.9 (115.12-1.33)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	REFMAC 5.8.0267	Depositor
R, $R_{free}$	0.162 , 0.181	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	8989	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	17.0	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: MN, JRH, ACT, K

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	0.74	0/4020	0.93	7/5468 (0.1%)
1	B	0.76	1/3996 (0.0%)	0.91	5/5437 (0.1%)
All	All	0.75	1/8016 (0.0%)	0.92	12/10905 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	140	GLU	CD-OE1	7.24	1.33	1.25

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	380	ARG	NE-CZ-NH2	-10.43	115.09	120.30
1	A	380	ARG	NE-CZ-NH2	-8.79	115.91	120.30
1	B	380	ARG	NE-CZ-NH1	8.55	124.58	120.30
1	A	51	ARG	NE-CZ-NH1	6.56	123.58	120.30
1	B	433	ARG	NE-CZ-NH2	-6.24	117.18	120.30
1	A	380	ARG	NE-CZ-NH1	6.21	123.41	120.30
1	A	96	ARG	NE-CZ-NH2	-6.00	117.30	120.30
1	A	15	PRO	N-CA-CB	5.55	109.96	103.30
1	A	28	ARG	NE-CZ-NH1	5.38	122.99	120.30
1	B	378	ARG	NE-CZ-NH1	-5.24	117.68	120.30
1	B	351	ARG	NE-CZ-NH2	-5.22	117.69	120.30
1	A	15	PRO	CA-N-CD	-5.01	104.49	111.50

There are no chirality outliers.

There are no planarity outliers.

## 5.2 Too-close contacts

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	3925	0	3906	13	0
1	B	3901	0	3880	26	0
2	A	16	0	12	2	0
2	B	8	0	6	12	0
3	A	39	0	0	1	0
3	B	39	0	0	1	0
4	A	2	0	0	0	0
4	B	2	0	0	0	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
6	A	578	0	0	6	0
6	B	477	0	0	12	0
All	All	8989	0	7804	46	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 3.

All (46) 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:A:347:GLN:HG2	1:A:351[B]:ARG:NH2	1.68	1.08
2:B:902:ACT:H1	6:B:1035:HOH:O	1.79	0.81
1:A:347:GLN:HG2	1:A:351[B]:ARG:HH22	1.42	0.80
1:B:171:SER:HB2	2:B:901:ACT:H2	1.64	0.79
1:A:347:GLN:CG	1:A:351[B]:ARG:NH2	2.52	0.69
2:A:1203:ACT:H1	6:A:1780:HOH:O	1.93	0.69
1:B:28:ARG:HH12	2:B:902:ACT:H3	1.60	0.66
1:B:173:ASP:H	2:B:901:ACT:H1	1.61	0.64
1:A:347:GLN:CG	1:A:351[B]:ARG:HH22	2.10	0.63
2:B:901:ACT:C	6:B:1208:HOH:O	2.46	0.62
1:B:117:ASN:HB3	6:B:1314:HOH:O	2.00	0.61
1:B:173:ASP:CB	2:B:901:ACT:H1	2.36	0.54
1:B:173:ASP:CG	2:B:901:ACT:H1	2.29	0.53
1:B:173:ASP:H	2:B:901:ACT:CH3	2.23	0.52
2:A:1203:ACT:CH3	6:A:1780:HOH:O	2.51	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:B:903:JRH:C17	3:B:903:JRH:C15	2.87	0.51
3:A:1205:JRH:C17	3:A:1205:JRH:C15	2.89	0.51
1:B:392[B]:ARG:NH2	6:B:1004:HOH:O	2.42	0.50
1:B:294:HIS:HE1	6:B:1184:HOH:O	1.94	0.49
1:A:347:GLN:NE2	6:A:1301:HOH:O	2.33	0.49
1:A:346[A]:ARG:HD2	6:A:1388:HOH:O	2.14	0.47
1:B:28:ARG:HH12	2:B:902:ACT:CH3	2.27	0.47
1:B:117:ASN:ND2	6:B:1007:HOH:O	2.47	0.47
1:B:277:GLY:HA3	1:B:309:THR:O	2.14	0.47
1:B:215:GLU:OE2	1:B:282:THR:HG21	2.16	0.46
1:B:173:ASP:N	2:B:901:ACT:H1	2.29	0.46
1:B:117:ASN:ND2	1:B:347:GLN:NE2	2.64	0.46
1:A:408[A]:ARG:NH2	6:A:1309:HOH:O	2.48	0.45
2:B:902:ACT:CH3	6:B:1035:HOH:O	2.51	0.45
1:A:346[B]:ARG:HD2	1:A:358:ASP:HA	1.98	0.45
1:B:117:ASN:ND2	1:B:347:GLN:HE22	2.14	0.45
1:A:459:GLU:OE2	1:A:462:LYS:HE3	2.17	0.44
1:A:277:GLY:HA3	1:A:309:THR:O	2.18	0.44
1:A:448:TRP:CZ3	1:A:449[B]:LEU:HD23	2.53	0.44
1:B:14:GLU:N	6:B:1010:HOH:O	2.51	0.43
1:A:329:LEU:HA	1:A:330:THR:HA	1.80	0.42
1:B:173:ASP:HB3	2:B:901:ACT:H1	2.02	0.42
1:B:416:ILE:HG23	1:B:423:ASP:HB3	2.01	0.42
6:A:1704:HOH:O	1:B:509:LYS:HD3	2.20	0.41
1:B:117:ASN:CG	1:B:347:GLN:HE22	2.24	0.41
1:B:392[A]:ARG:HD2	6:B:1104:HOH:O	2.20	0.41
1:B:294:HIS:HD2	6:B:1003:HOH:O	2.03	0.41
1:B:408[A]:ARG:NH2	6:B:1015:HOH:O	2.55	0.40
1:A:176:TRP:CD2	1:A:240:GLY:HA2	2.56	0.40
1:B:303:HIS:HE1	6:B:1001:HOH:O	2.04	0.40
1:B:329:LEU:HA	1:B:330:THR:HA	1.86	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	507/519 (98%)	495 (98%)	12 (2%)	0	100	100
1	B	504/519 (97%)	495 (98%)	9 (2%)	0	100	100
All	All	1011/1038 (97%)	990 (98%)	21 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	421/430 (98%)	420 (100%)	1 (0%)	93	82
1	B	418/430 (97%)	416 (100%)	2 (0%)	88	71
All	All	839/860 (98%)	836 (100%)	3 (0%)	91	79

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	74	TRP
1	B	74	TRP
1	B	452	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	141	ASN
1	A	154	GLN
1	A	457	ASN
1	B	117	ASN
1	B	154	GLN
1	B	294	HIS
1	B	303	HIS

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Mol	Chain	Res	Type
1	B	347	GLN
1	B	377	HIS
1	B	457	ASN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

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

### 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

Of 14 ligands modelled in this entry, 6 are monoatomic - leaving 8 for Mogul analysis.

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

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	ACT	A	1202	-	1,3,3	4.51	1 (100%)	0,3,3	-	-
3	JRH	B	903	5,4	40,43,43	1.75	4 (10%)	51,71,71	1.44	6 (11%)
2	ACT	A	1201	-	1,3,3	3.60	1 (100%)	0,3,3	-	-
2	ACT	B	901	-	1,3,3	7.50	1 (100%)	0,3,3	-	-
2	ACT	A	1203	-	1,3,3	2.34	1 (100%)	0,3,3	-	-
3	JRH	A	1205	5,4	40,43,43	1.31	2 (5%)	51,71,71	1.37	6 (11%)
2	ACT	B	902	-	1,3,3	1.51	0	0,3,3	-	-
2	ACT	A	1204	-	1,3,3	1.87	0	0,3,3	-	-

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	JRH	B	903	5,4	-	0/18/81/81	0/4/5/5
3	JRH	A	1205	5,4	-	0/18/81/81	0/4/5/5

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	901	ACT	CH3-C	-7.50	1.39	1.48
3	B	903	JRH	C8-C10	-7.31	1.46	1.54
3	A	1205	JRH	C8-C23	6.18	1.62	1.56
3	B	903	JRH	C8-C23	5.71	1.62	1.56
2	A	1202	ACT	CH3-C	4.51	1.54	1.48
3	A	1205	JRH	C8-C10	-3.60	1.50	1.54
2	A	1201	ACT	CH3-C	3.60	1.53	1.48
3	B	903	JRH	C2-C1	2.57	1.44	1.40
3	B	903	JRH	P1-O9	-2.43	1.45	1.54
2	A	1203	ACT	CH3-C	2.34	1.51	1.48

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	903	JRH	C13-C3-C2	-6.77	114.09	121.48
3	A	1205	JRH	C13-C3-C2	-4.93	116.09	121.48
3	A	1205	JRH	C3-C2-N2	-3.50	118.76	120.49
3	B	903	JRH	C25-C23-C24	-2.71	109.17	113.53
3	B	903	JRH	C10-N4-C9	-2.55	121.58	125.42
3	A	1205	JRH	C17-C13-C3	2.43	119.57	112.13
3	B	903	JRH	O8-P1-O9	2.35	116.64	107.64
3	B	903	JRH	O8-P1-O6	-2.29	100.65	106.73
3	A	1205	JRH	C8-C10-N4	-2.19	114.05	116.97
3	B	903	JRH	C17-C13-C3	2.18	118.79	112.13
3	A	1205	JRH	C12-C13-C3	-2.14	106.25	111.14
3	A	1205	JRH	C25-C23-C24	-2.08	110.18	113.53

There are no chirality outliers.

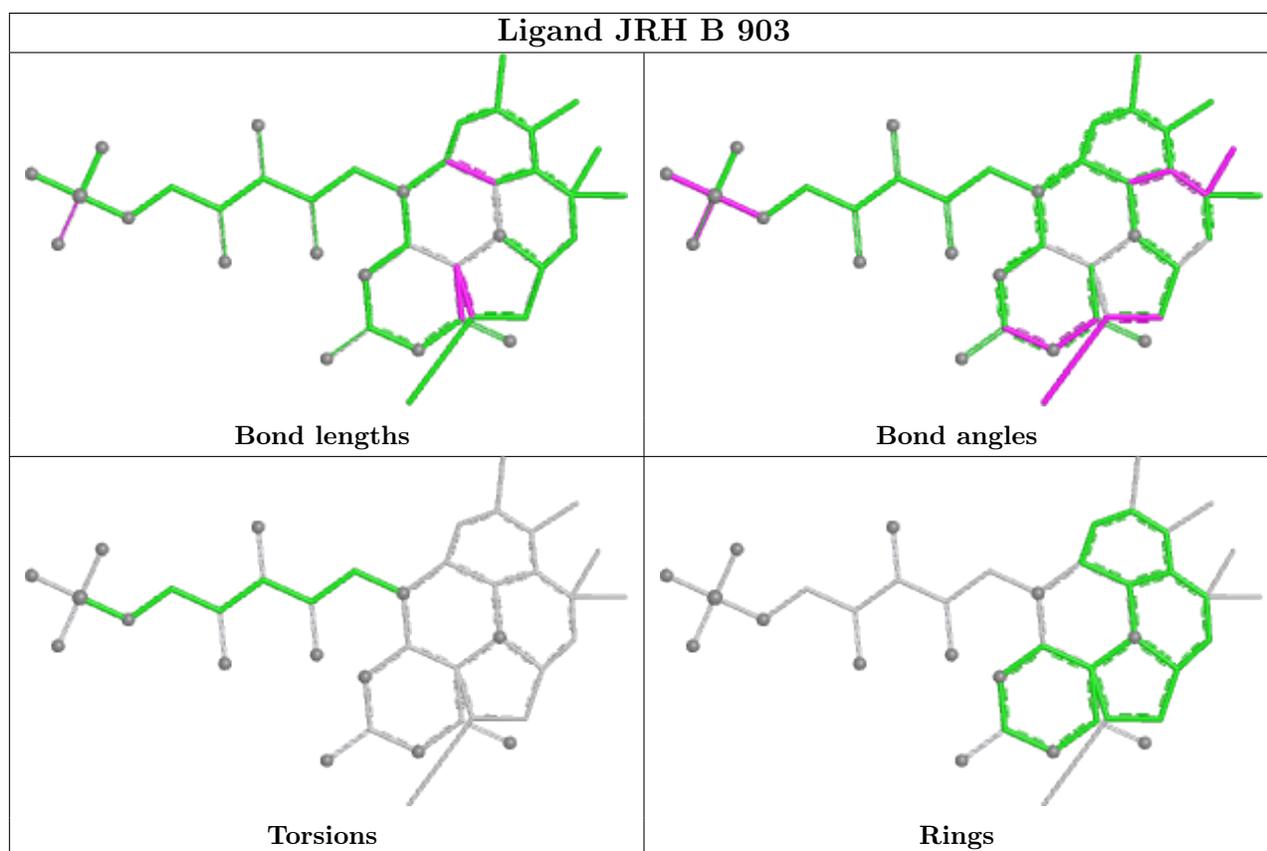
There are no torsion outliers.

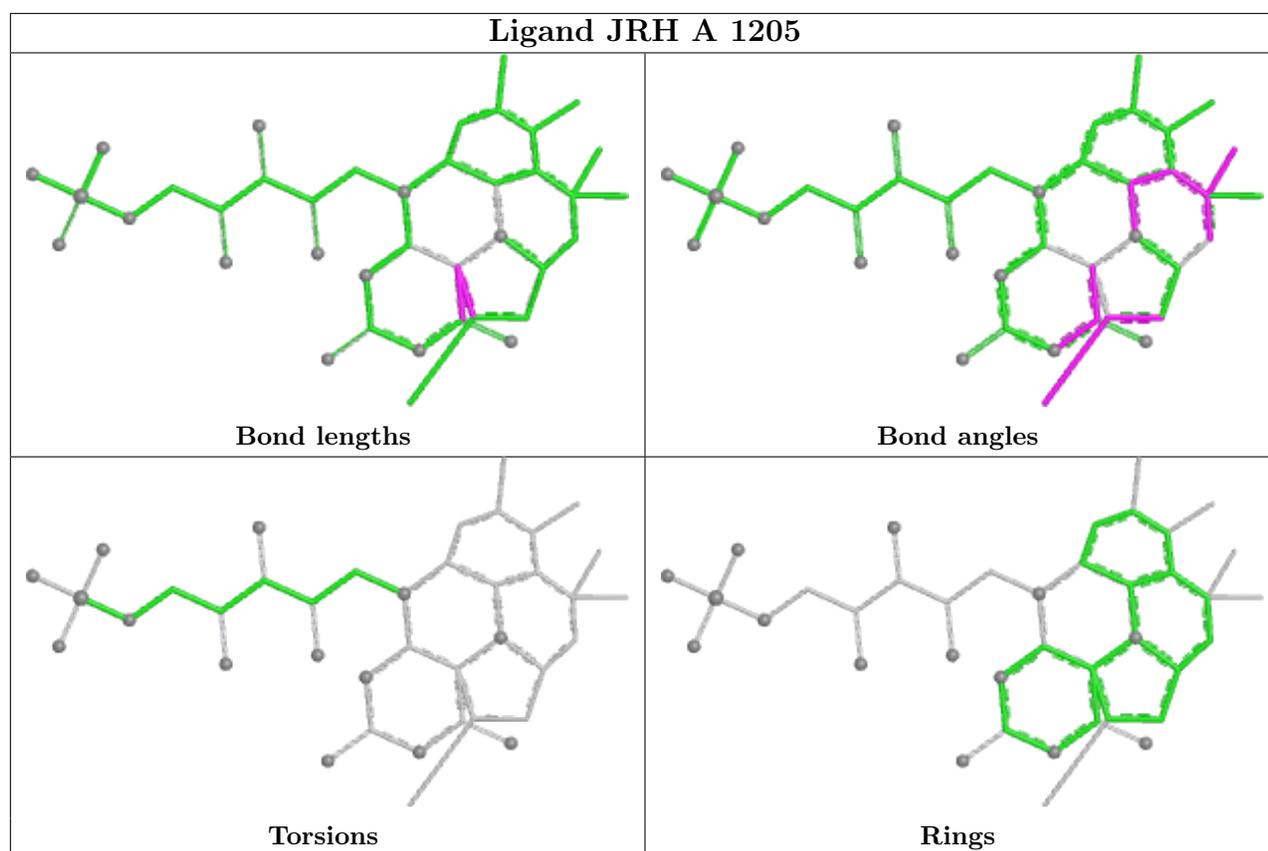
There are no ring outliers.

5 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	903	JRH	1	0
2	B	901	ACT	8	0
2	A	1203	ACT	2	0
3	A	1205	JRH	1	0
2	B	902	ACT	4	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.