



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 01:10 PM UTC

PDB ID : 1T9Y / pdb_00001t9y
Title : Structural Basis of Multidrug Transport by the AcrB Multidrug Efflux Pump
Authors : Yu, E.W.; McDermott, G.; Nikaido, H.
Deposited on : 2004-05-19
Resolution : 3.64 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

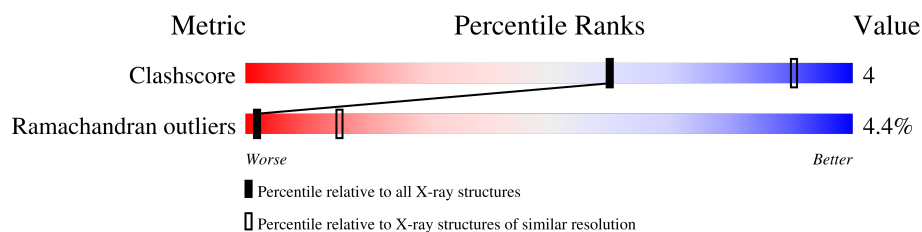
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.64 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	190562	1014 (3.74-3.54)
Ramachandran outliers	187476	1123 (3.76-3.52)

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

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	1049	84% 12% . .

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 7784 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.

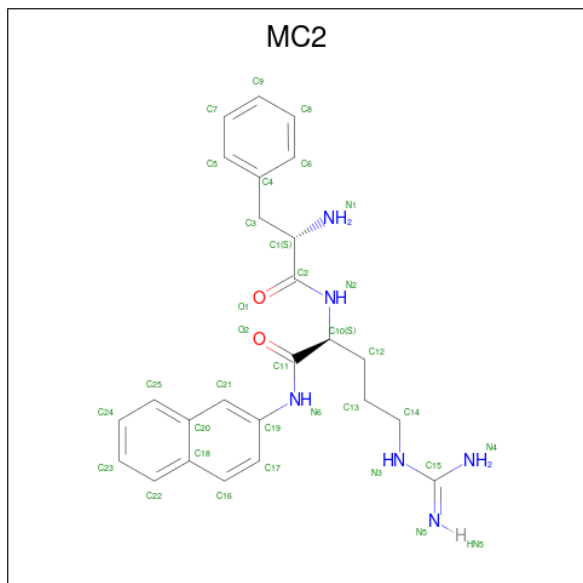
- Molecule 1 is a protein called Acriflavine resistance protein B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	1016	7718	4964	1275	1436	43	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	109	ALA	ASN	engineered mutation	UNP P31224

- Molecule 2 is N2-(L-PHENYLALANYL)-N1-(NAPHTHALENYL)-L-ARGININAMIDE (CCD ID: MC2) (formula: C₂₅H₃₀N₆O₂).



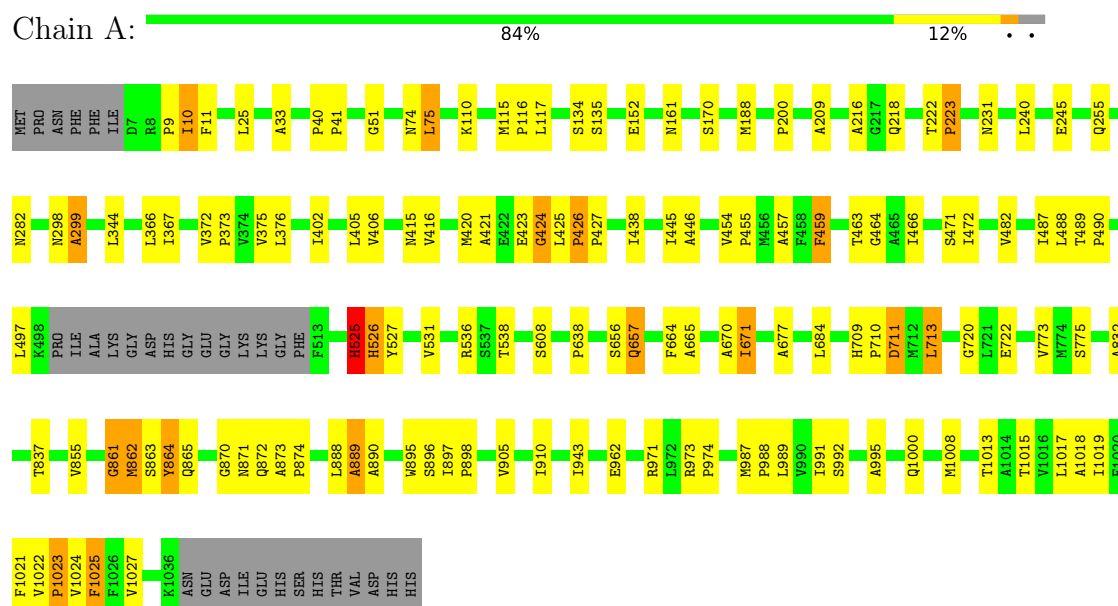
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	33	25	6	2	0	0
2	A	1	33	25	6	2	0	0

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: Acriflavine resistance protein B



4 Data and refinement statistics

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

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, α , β , γ	144.92Å 144.92Å 516.67Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	182.57 – 3.64	Depositor
% Data completeness (in resolution range)	(Not available) (182.57-3.64)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC 5.1	Depositor
R, R_{free}	0.277 , 0.340	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	7784	wwPDB-VP
Average B, all atoms (Å ²)	93.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MC2

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	0.49	1/7861 (0.0%)	0.81	6/10676 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	2	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	905	VAL	CA-CB	7.20	1.58	1.54

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	426	PRO	N-CA-C	7.10	119.36	110.70
1	A	525	HIS	CA-C-N	6.22	132.90	121.70
1	A	525	HIS	C-N-CA	6.22	132.90	121.70
1	A	862	MET	N-CA-C	5.69	122.87	113.89
1	A	862	MET	CB-CA-C	5.19	118.68	109.75
1	A	711	ASP	N-CA-C	5.01	125.02	111.00

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	A	711	ASP	CA
1	A	862	MET	CA

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	525	HIS	Peptide
1	A	861	GLY	Peptide

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	7718	0	7876	66	6
2	A	66	0	58	2	0
All	All	7784	0	7934	68	6

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 4.

All (68) 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:525:HIS:HB2	1:A:526:HIS:HB2	1.60	0.84
1:A:525:HIS:CB	1:A:526:HIS:HB2	2.18	0.74
1:A:709:HIS:CG	1:A:709:HIS:O	2.51	0.63
1:A:1024:VAL:O	1:A:1025:PHE:CG	2.57	0.58
1:A:713:LEU:O	1:A:832:ALA:HB2	2.04	0.57
1:A:372:VAL:N	1:A:373:PRO:HD2	2.21	0.56
1:A:670:ALA:O	1:A:671:ILE:O	2.24	0.55
1:A:861:GLY:O	1:A:862:MET:HB2	2.05	0.55
2:A:7001:MC2:H21	2:A:7001:MC2:O2	2.06	0.55
1:A:344:LEU:HD23	1:A:402:ILE:HD11	1.89	0.54
1:A:862:MET:HG2	1:A:862:MET:O	2.07	0.54
1:A:240:LEU:HD12	1:A:245:GLU:HB3	1.90	0.54
1:A:1015:THR:O	1:A:1019:ILE:HG22	2.07	0.54
1:A:188:MET:HE1	1:A:200:PRO:HB3	1.91	0.53
1:A:1022:VAL:HG22	1:A:1023:PRO:HD2	1.91	0.52
1:A:525:HIS:HB2	1:A:526:HIS:CB	2.36	0.52
1:A:446:ALA:HB2	1:A:482:VAL:HG21	1.92	0.52
1:A:74:ASN:O	1:A:75:LEU:CB	2.57	0.52

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:895:TRP:HA	1:A:895:TRP:CE3	2.46	0.51
1:A:218:GLN:HE21	1:A:231:ASN:HD21	1.59	0.51
1:A:25:LEU:C	1:A:25:LEU:HD13	2.35	0.51
1:A:870:GLY:O	1:A:872:GLN:N	2.43	0.51
1:A:188:MET:HE2	1:A:773:VAL:HG13	1.93	0.50
1:A:454:VAL:N	1:A:455:PRO:HD2	2.26	0.50
1:A:664:PHE:O	1:A:665:ALA:HB3	2.12	0.50
1:A:425:LEU:C	1:A:427:PRO:HD2	2.37	0.49
1:A:33:ALA:HB1	1:A:299:ALA:HB3	1.93	0.49
1:A:415:ASN:HB3	1:A:438:ILE:HD11	1.94	0.48
1:A:895:TRP:HA	1:A:895:TRP:HE3	1.78	0.48
1:A:873:ALA:HB3	1:A:874:PRO:HD3	1.95	0.48
1:A:525:HIS:CA	1:A:526:HIS:HB2	2.44	0.47
1:A:1018:ALA:O	1:A:1024:VAL:HB	2.15	0.47
1:A:525:HIS:CB	1:A:526:HIS:CB	2.90	0.46
1:A:10:ILE:CD1	1:A:10:ILE:N	2.79	0.46
1:A:910:ILE:HG23	1:A:1013:THR:HG21	1.98	0.46
1:A:527:TYR:O	1:A:531:VAL:HG23	2.16	0.45
1:A:445:ILE:HG23	1:A:943:ILE:HG21	1.99	0.45
1:A:656:SER:O	1:A:657:GLN:HB2	2.17	0.45
1:A:222:THR:HB	1:A:223:PRO:HD3	1.98	0.45
1:A:344:LEU:HD21	1:A:376:LEU:HD13	1.98	0.45
1:A:457:ALA:HB2	1:A:471:SER:HB3	1.99	0.45
1:A:987:MET:HE1	1:A:1008:MET:HE2	1.99	0.45
1:A:1023:PRO:HB3	1:A:1027:VAL:HG13	1.99	0.44
1:A:684:LEU:CD1	1:A:855:VAL:HG13	2.46	0.44
1:A:989:LEU:HD22	1:A:1000:GLN:HE21	1.83	0.44
1:A:117:LEU:HD23	1:A:117:LEU:N	2.32	0.44
1:A:367:ILE:HD11	1:A:497:LEU:HD13	2.00	0.44
1:A:423:GLU:O	1:A:424:GLY:C	2.61	0.44
1:A:973:ARG:HB3	1:A:974:PRO:HD3	1.99	0.44
1:A:888:LEU:O	1:A:889:ALA:HB2	2.16	0.44
1:A:1022:VAL:O	1:A:1023:PRO:O	2.36	0.44
1:A:115:MET:N	1:A:116:PRO:CD	2.81	0.43
1:A:10:ILE:N	1:A:10:ILE:HD13	2.33	0.43
1:A:463:THR:HG23	1:A:466:ILE:HB	2.00	0.43
1:A:897:ILE:N	1:A:898:PRO:CD	2.82	0.43
1:A:40:PRO:HA	1:A:41:PRO:HD3	1.92	0.43
1:A:489:THR:HB	1:A:490:PRO:HD3	2.01	0.42
1:A:372:VAL:HG11	1:A:406:VAL:HG22	2.02	0.42
1:A:282:ASN:HD21	1:A:608:SER:HA	1.85	0.42

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:416:VAL:O	1:A:420:MET:HG3	2.20	0.41
1:A:298:ASN:O	1:A:299:ALA:C	2.64	0.41
2:A:7002:MC2:HN2	2:A:7002:MC2:C17	2.34	0.41
1:A:459:PHE:HB2	1:A:464:GLY:HA2	2.02	0.40
1:A:863:SER:HA	1:A:864:TYR:HA	1.84	0.40
1:A:987:MET:N	1:A:988:PRO:CD	2.84	0.40
1:A:426:PRO:N	1:A:427:PRO:CD	2.85	0.40
1:A:375:VAL:HG11	1:A:405:LEU:HD22	2.04	0.40
1:A:487:ILE:O	1:A:488:LEU:HB3	2.21	0.40

All (6) 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:11:PHE:CE2	1:A:890:ALA:O[3_555]	1.47	0.73
1:A:11:PHE:CD2	1:A:890:ALA:O[3_555]	1.78	0.42
1:A:51:GLY:O	1:A:216:ALA:O[2_555]	1.81	0.39
1:A:536:ARG:CG	1:A:962:GLU:OE2[17_555]	1.84	0.36
1:A:11:PHE:CE2	1:A:890:ALA:C[3_555]	1.96	0.24
1:A:11:PHE:CZ	1:A:890:ALA:O[3_555]	2.18	0.02

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	1012/1049 (96%)	848 (84%)	119 (12%)	45 (4%)	2 15

All (45) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	75	LEU
1	A	134	SER

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	135	SER
1	A	255	GLN
1	A	299	ALA
1	A	424	GLY
1	A	459	PHE
1	A	526	HIS
1	A	671	ILE
1	A	711	ASP
1	A	871	ASN
1	A	889	ALA
1	A	971	ARG
1	A	992	SER
1	A	1017	LEU
1	A	1021	PHE
1	A	1023	PRO
1	A	1025	PHE
1	A	9	PRO
1	A	152	GLU
1	A	657	GLN
1	A	991	ILE
1	A	161	ASN
1	A	209	ALA
1	A	421	ALA
1	A	525	HIS
1	A	713	LEU
1	A	720	GLY
1	A	865	GLN
1	A	995	ALA
1	A	110	LYS
1	A	366	LEU
1	A	538	THR
1	A	638	PRO
1	A	710	PRO
1	A	722	GLU
1	A	775	SER
1	A	837	THR
1	A	896	SER
1	A	223	PRO
1	A	677	ALA
1	A	864	TYR
1	A	170	SER
1	A	472	ILE

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	10	ILE

5.3.2 Protein sidechains [i](#)

There are no protein residues with a non-rotameric sidechain to report in this entry.

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](#)

2 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	MC2	A	7002	-	35,35,35	1.13	3 (8%)	45,46,46	1.59	7 (15%)
2	MC2	A	7001	-	35,35,35	1.05	3 (8%)	45,46,46	0.99	3 (6%)

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	MC2	A	7002	-	-	8/27/27/27	0/3/3/3
2	MC2	A	7001	-	-	11/27/27/27	0/3/3/3

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	7002	MC2	C19-N6	-3.36	1.34	1.41
2	A	7002	MC2	C18-C20	2.95	1.49	1.42
2	A	7001	MC2	C18-C20	2.71	1.48	1.42
2	A	7001	MC2	C19-N6	-2.26	1.37	1.41
2	A	7002	MC2	C15-N4	-2.07	1.26	1.34
2	A	7001	MC2	C15-N4	-2.06	1.26	1.34

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	7002	MC2	C10-C11-N6	5.78	132.00	115.28
2	A	7002	MC2	C19-N6-C11	-4.17	117.85	127.37
2	A	7002	MC2	O2-C11-N6	-3.92	115.63	123.92
2	A	7002	MC2	O2-C11-C10	-3.88	112.36	120.48
2	A	7001	MC2	C11-C10-N2	3.06	119.40	111.11
2	A	7001	MC2	C12-C10-C11	-3.05	102.65	110.11
2	A	7001	MC2	C19-N6-C11	-2.84	120.90	127.37
2	A	7002	MC2	C4-C3-C1	-2.60	108.82	114.13
2	A	7002	MC2	C11-C10-N2	2.52	117.92	111.11
2	A	7002	MC2	C10-N2-C2	2.19	126.34	121.65

There are no chirality outliers.

All (19) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	7001	MC2	C10-C11-N6-C19
2	A	7001	MC2	N1-C1-C2-N2
2	A	7001	MC2	C3-C1-C2-N2
2	A	7001	MC2	C3-C1-C2-O1
2	A	7002	MC2	C10-C11-N6-C19
2	A	7002	MC2	C12-C10-N2-C2
2	A	7002	MC2	O2-C11-N6-C19
2	A	7002	MC2	C17-C19-N6-C11
2	A	7002	MC2	C21-C19-N6-C11
2	A	7001	MC2	C11-C10-N2-C2
2	A	7002	MC2	C12-C13-C14-N3

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms
2	A	7001	MC2	O2-C11-N6-C19
2	A	7001	MC2	C10-C12-C13-C14
2	A	7001	MC2	C2-C1-C3-C4
2	A	7002	MC2	C11-C10-N2-C2
2	A	7001	MC2	N1-C1-C2-O1
2	A	7002	MC2	C11-C10-C12-C13
2	A	7001	MC2	N1-C1-C3-C4
2	A	7001	MC2	C12-C10-N2-C2

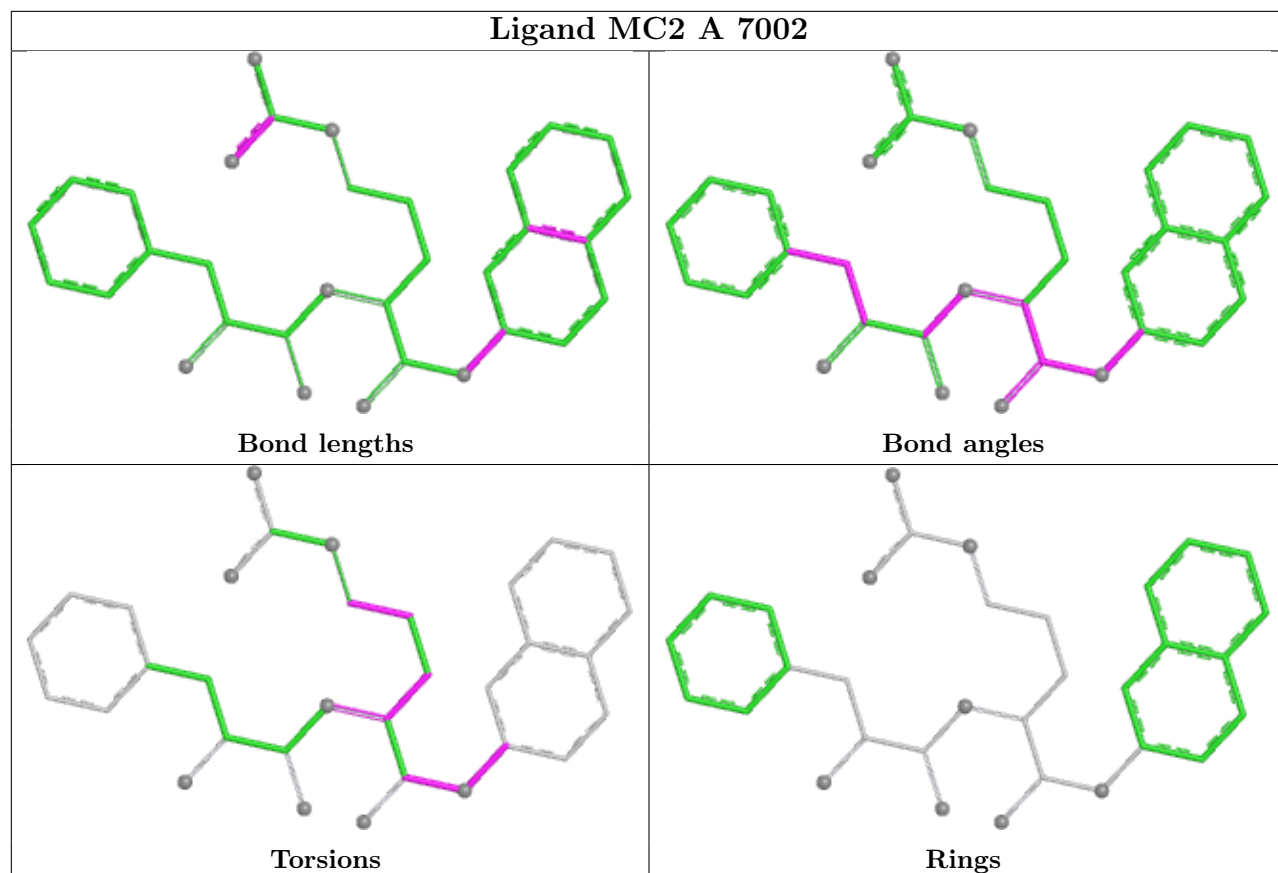
There are no ring outliers.

2 monomers are involved in 2 short contacts:

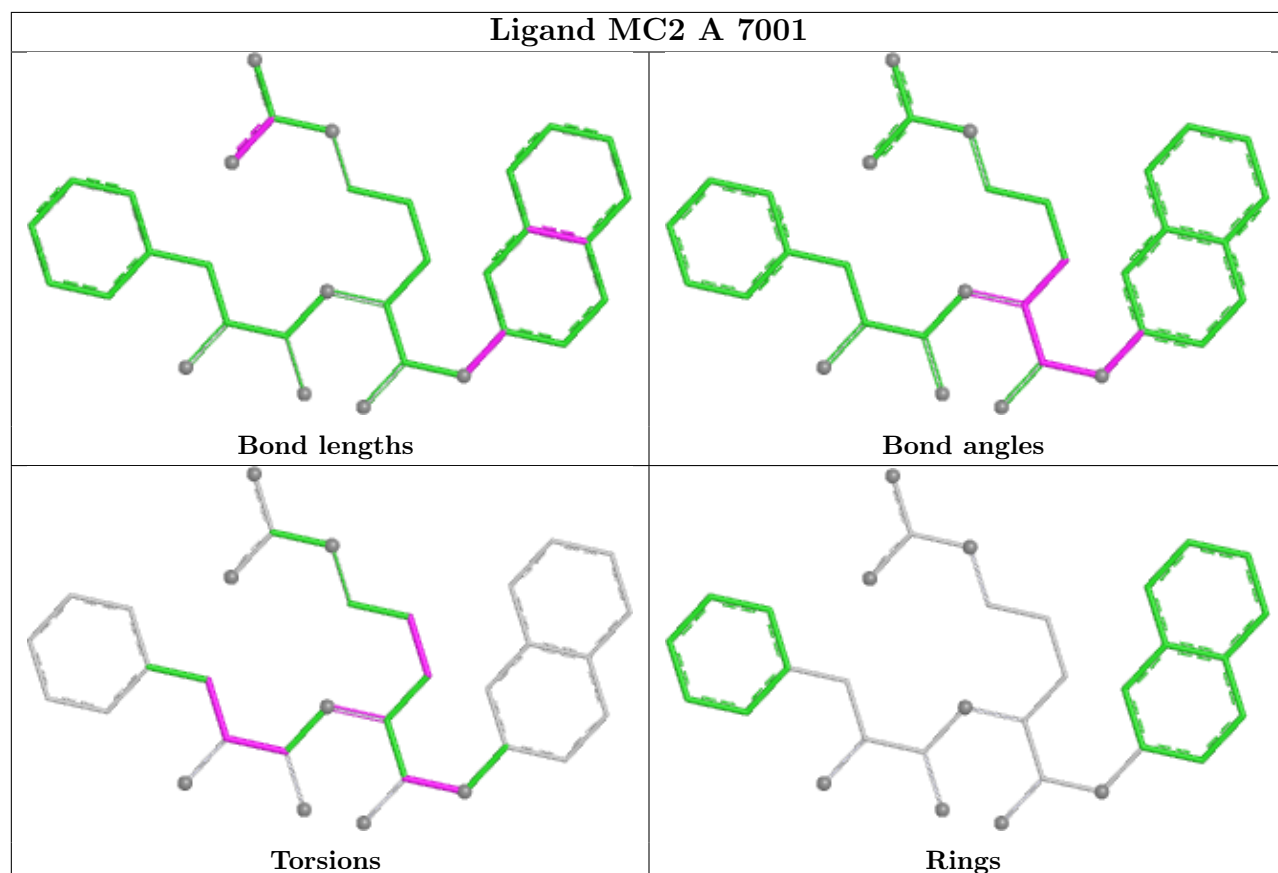
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	7002	MC2	1	0
2	A	7001	MC2	1	0

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 MC2 A 7002



Ligand MC2 A 7001



5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

6 Fit of model and data ⓘ

6.1 Protein, DNA and RNA chains ⓘ

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates ⓘ

EDS was not executed - this section is therefore empty.

6.4 Ligands ⓘ

EDS was not executed - this section is therefore empty.

6.5 Other polymers ⓘ

EDS was not executed - this section is therefore empty.