Full wwPDB X-ray Structure Validation Report (i)

Oct 25, 2023 – 03:00 AM EDT

PDB ID	:	2ZC6
Title	:	Penicillin-binding protein 1A (PBP 1A) acyl-enzyme complex (tebipenem) from Streptococcus pneumoniae
Authors	:	Yamada, M.; Watanabe, T.; Takeuchi, Y.
Deposited on	:	2007-11-02
Resolution	:	2.70 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 (i) 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 (1)) were used in the production of this report:

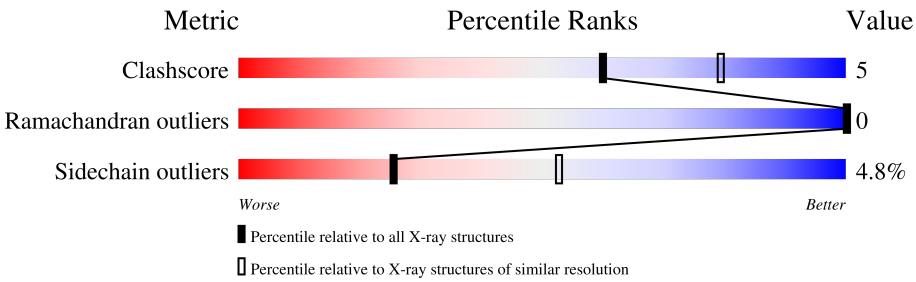
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 2.70 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	3122 (2.70-2.70)
Ramachandran outliers	138981	3069 (2.70-2.70)
Sidechain outliers	138945	3069 (2.70-2.70)

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%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	24	67% 33%
1	C	24	58% • • 33%
2	B	390	85% 12% • •
2	D	390	87% 10% • •

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 6398 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 Penicillin-binding protein 1A.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
1	A	16	124	78	20	26	0	0	0
1	C	16	124	78	20	26	0	0	0

- Molecule 2 is a protein called Penicillin-binding protein 1A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	384	3028	1913	495	607	13	0	0	0
2	D	384	3024	1911	495	605	13	0	0	0

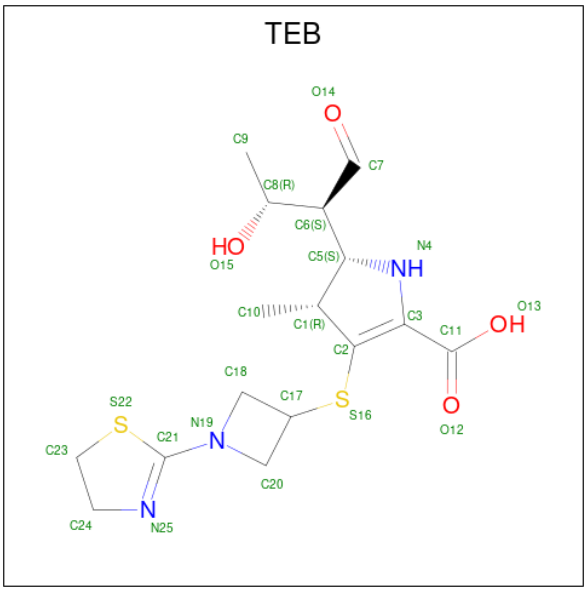
There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	545	GLN	ARG	engineered mutation	UNP Q549Y6
D	545	GLN	ARG	engineered mutation	UNP Q549Y6

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Zn		
3	B	4	4	4	0	0
3	D	4	4	4	0	0

- Molecule 4 is (4R,5S)-3-(1-(4,5-dihydrothiazol-2-yl)azetidin-3-ylthio)-5-((2S,3R)-3-hydroxy-1-oxobutan-2-yl)-4-methyl-4,5- dihydro-1H-pyrrole-2-carboxylic acid (three-letter code: TEB) (formula: $C_{16}H_{23}N_3O_4S_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
4	B	1	25	16	3	4	2	0	0
			Total	C	N	O	S		
4	D	1	25	16	3	4	2	0	0

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
5	B	25	25	25	0	0
			Total	O		
5	D	15	15	15	0	0

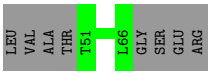
3 Residue-property plots (i)

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: Penicillin-binding protein 1A

Chain A:

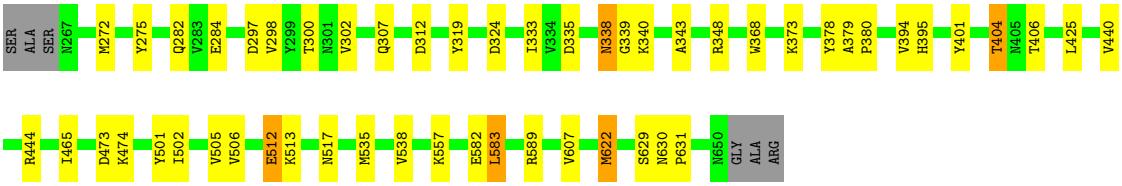


• Molecule 1: Penicillin-binding protein 1A

Chain C:

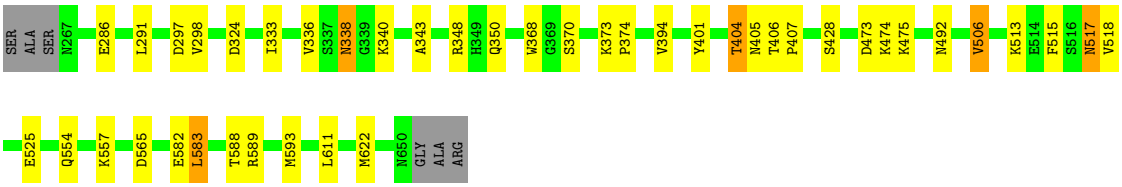
• Molecule 2: Penicillin-binding protein 1A

Chain B:



• Molecule 2: Penicillin-binding protein 1A

Chain D:



4 Data and refinement statistics (i)

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

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α, β, γ	185.75Å 50.28Å 109.53Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.88 – 2.70	Depositor
% Data completeness (in resolution range)	99.9 (29.88-2.70)	Depositor
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC 5.2.0005	Depositor
R, R_{free}	0.228 , 0.271	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	6398	wwPDB-VP
Average B, all atoms (Å^2)	42.0	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: TEB, ZN

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	0.37	0/124	0.50	0/166
1	C	0.42	0/124	0.56	0/166
2	B	0.38	0/3103	0.51	0/4226
2	D	0.38	0/3099	0.51	0/4221
All	All	0.38	0/6450	0.51	0/8779

There are no bond length outliers.

There are no bond angle outliers.

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	124	0	118	0	0
1	C	124	0	118	1	0
2	B	3028	0	2857	33	0
2	D	3024	0	2853	22	0
3	B	4	0	0	0	0
3	D	4	0	0	0	0
4	B	25	0	21	0	0
4	D	25	0	21	1	0
5	B	25	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	D	15	0	0	0	0
All	All	6398	0	5988	57	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 5.

All (57) 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)
2:D:404:THR:HG23	2:D:406:THR:H	1.42	0.83
2:B:404:THR:HG23	2:B:406:THR:H	1.42	0.82
2:D:324:ASP:O	2:D:348:ARG:NH1	2.23	0.72
2:D:297:ASP:HB2	2:D:506:VAL:HG22	1.72	0.70
2:B:282:GLN:HE22	2:B:501:TYR:H	1.46	0.63
2:D:622:MET:HA	2:D:622:MET:HE3	1.82	0.62
2:B:401:TYR:O	2:B:404:THR:HG22	2.02	0.59
2:D:401:TYR:O	2:D:404:THR:HG22	2.03	0.59
2:B:335:ASP:HB3	2:B:338:ASN:HD21	1.68	0.58
2:B:506:VAL:HG12	2:B:512:GLU:HB2	1.88	0.56
2:D:333:ILE:HD13	2:D:343:ALA:HB3	1.88	0.55
2:B:368:TRP:CD2	2:B:583:LEU:HD22	2.42	0.54
2:D:338:ASN:HD22	2:D:340:LYS:H	1.55	0.54
2:D:333:ILE:HG13	2:D:593:MET:HG3	1.88	0.54
2:B:324:ASP:O	2:B:348:ARG:NH1	2.41	0.54
2:B:629:SER:O	2:B:631:PRO:HD3	2.08	0.54
2:B:401:TYR:HB2	2:B:404:THR:CG2	2.38	0.53
2:B:401:TYR:HB2	2:B:404:THR:HG21	1.90	0.52
2:D:582:GLU:HG2	2:D:611:LEU:O	2.09	0.52
2:D:517:ASN:N	2:D:517:ASN:OD1	2.42	0.52
2:B:622:MET:HE3	2:B:622:MET:HA	1.92	0.52
2:D:368:TRP:CD2	2:D:583:LEU:HD22	2.44	0.51
2:B:282:GLN:NE2	2:B:502:ILE:HG12	2.26	0.50
2:B:297:ASP:HB2	2:B:506:VAL:CG2	2.42	0.50
2:D:373:LYS:HB2	2:D:374:PRO:HD3	1.95	0.48
2:D:404:THR:HG23	2:D:406:THR:N	2.21	0.47
2:B:272:MET:HE1	2:B:302:VAL:HG11	1.96	0.47
1:C:57:ASP:HB3	1:C:63:ILE:HD13	1.98	0.46
2:B:282:GLN:HE21	2:B:502:ILE:HG12	1.80	0.46
2:B:373:LYS:HE2	2:B:465:ILE:HG22	1.97	0.46
2:B:394:VAL:HG22	2:B:395:HIS:H	1.81	0.45
2:D:291:LEU:HD22	2:D:298:VAL:HG21	1.98	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:554:GLN:HB3	2:D:588:THR:HG22	1.99	0.45
2:B:312:ASP:HB3	2:B:319:TYR:HE1	1.82	0.45
2:B:440:VAL:O	2:B:444:ARG:HD2	2.18	0.44
2:B:338:ASN:HD22	2:B:339:GLY:N	2.16	0.44
2:D:338:ASN:ND2	2:D:340:LYS:H	2.15	0.43
2:B:535:MET:HA	2:B:538:VAL:HG23	2.00	0.43
2:B:338:ASN:HD22	2:B:340:LYS:H	1.67	0.43
2:B:300:THR:OG1	2:B:302:VAL:HG12	2.18	0.43
2:B:379:ALA:HB3	2:B:380:PRO:HD3	2.01	0.43
2:D:286:GLU:HB3	2:D:515:PHE:CE2	2.54	0.42
2:B:404:THR:HG23	2:B:406:THR:N	2.22	0.42
2:B:582:GLU:C	2:B:583:LEU:HG	2.40	0.42
2:B:275:TYR:CZ	2:B:302:VAL:HB	2.55	0.41
2:B:282:GLN:NE2	2:B:501:TYR:H	2.16	0.41
2:B:298:VAL:HG22	2:B:505:VAL:HG12	2.02	0.41
2:D:401:TYR:HB2	2:D:404:THR:HG21	2.02	0.41
2:D:406:THR:HA	2:D:407:PRO:HD3	1.94	0.41
2:B:378:TYR:CD1	2:B:425:LEU:HD13	2.56	0.41
2:D:336:VAL:CG1	2:D:492:ASN:HB3	2.50	0.41
2:B:338:ASN:ND2	2:B:340:LYS:H	2.17	0.40
2:B:368:TRP:O	2:B:583:LEU:HD13	2.21	0.40
4:D:701:TEB:H10A	4:D:701:TEB:H6	1.99	0.40
2:D:370:SER:HB3	2:D:557:LYS:HZ3	1.87	0.40
2:D:404:THR:HG23	2:D:405:ASN:N	2.37	0.40
2:B:333:ILE:HD13	2:B:343:ALA:HB3	2.04	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	A	14/24 (58%)	13 (93%)	1 (7%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	14/24 (58%)	14 (100%)	0	0	100	100
2	B	382/390 (98%)	362 (95%)	20 (5%)	0	100	100
2	D	382/390 (98%)	364 (95%)	18 (5%)	0	100	100
All	All	792/828 (96%)	753 (95%)	39 (5%)	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	13/21 (62%)	13 (100%)	0	100	100
1	C	13/21 (62%)	12 (92%)	1 (8%)	13	30
2	B	323/327 (99%)	308 (95%)	15 (5%)	27	54
2	D	322/327 (98%)	306 (95%)	16 (5%)	24	51
All	All	671/696 (96%)	639 (95%)	32 (5%)	25	53

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	284	GLU
2	B	307	GLN
2	B	338	ASN
2	B	404	THR
2	B	473	ASP
2	B	474	LYS
2	B	512	GLU
2	B	513	LYS
2	B	517	ASN
2	B	557	LYS
2	B	583	LEU
2	B	589	ARG
2	B	607	VAL

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Mol	Chain	Res	Type
2	B	622	MET
2	B	630	ASN
1	C	63	ILE
2	D	338	ASN
2	D	350	GLN
2	D	394	VAL
2	D	404	THR
2	D	428	SER
2	D	473	ASP
2	D	474	LYS
2	D	475	LYS
2	D	506	VAL
2	D	513	LYS
2	D	517	ASN
2	D	518	VAL
2	D	525	GLU
2	D	565	ASP
2	D	583	LEU
2	D	589	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
2	B	282	GLN
2	B	338	ASN
2	B	438	ASN
2	B	443	ASN
2	B	450	ASN
2	B	650	ASN
1	C	60	ASN
2	D	267	ASN
2	D	290	ASN
2	D	304	GLN
2	D	338	ASN
2	D	350	GLN
2	D	443	ASN
2	D	450	ASN
2	D	650	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 10 ligands modelled in this entry, 8 are monoatomic - leaving 2 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	$\#\|Z\| > 2$
4	TEB	D	701	2	24,27,27	1.78	5 (20%)	17,39,39	1.69	5 (29%)
4	TEB	B	701	2	24,27,27	1.70	5 (20%)	17,39,39	1.60	3 (17%)

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
4	TEB	D	701	2	-	5/13/53/53	0/3/3/3
4	TEB	B	701	2	-	5/13/53/53	0/3/3/3

All (10) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	701	TEB	C3-C11	4.82	1.56	1.48

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	701	TEB	C3-C11	4.61	1.55	1.48
4	D	701	TEB	C20-N19	3.56	1.50	1.47
4	B	701	TEB	C20-N19	3.27	1.49	1.47
4	B	701	TEB	C21-S22	2.77	1.80	1.75
4	D	701	TEB	C21-S22	2.69	1.80	1.75
4	D	701	TEB	C18-C17	2.52	1.57	1.54
4	D	701	TEB	C20-C17	2.50	1.57	1.54
4	B	701	TEB	C20-C17	2.46	1.57	1.54
4	B	701	TEB	C18-C17	2.16	1.57	1.54

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	D	701	TEB	C11-C3-N4	-4.02	115.31	120.38
4	B	701	TEB	C11-C3-N4	-3.27	116.26	120.38
4	B	701	TEB	O13-C11-C3	-3.17	111.54	116.76
4	B	701	TEB	O13-C11-O12	2.88	130.19	123.61
4	D	701	TEB	O13-C11-O12	2.62	129.61	123.61
4	D	701	TEB	O13-C11-C3	-2.20	113.13	116.76
4	D	701	TEB	N19-C21-N25	2.02	126.20	123.34
4	D	701	TEB	C17-C20-N19	-2.00	86.61	87.96

There are no chirality outliers.

All (10) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	B	701	TEB	C1-C5-C6-C8
4	B	701	TEB	O13-C11-C3-N4
4	B	701	TEB	O12-C11-C3-N4
4	B	701	TEB	O13-C11-C3-C2
4	B	701	TEB	O12-C11-C3-C2
4	D	701	TEB	C1-C5-C6-C8
4	D	701	TEB	O12-C11-C3-N4
4	D	701	TEB	O13-C11-C3-N4
4	D	701	TEB	O12-C11-C3-C2
4	D	701	TEB	O13-C11-C3-C2

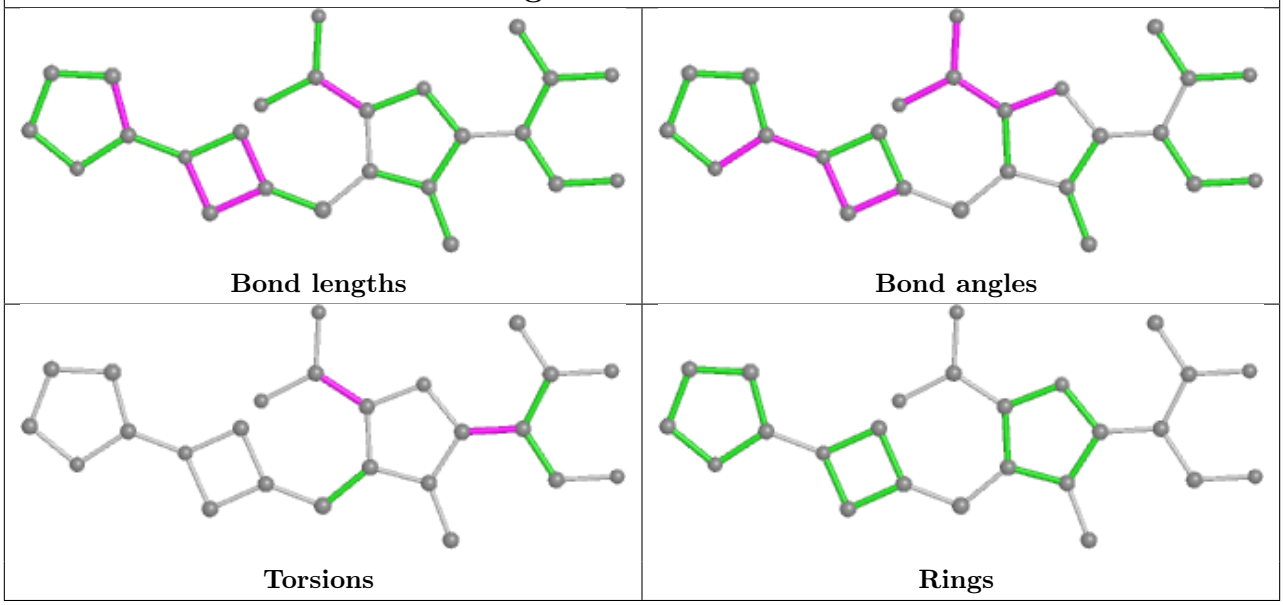
There are no ring outliers.

1 monomer is involved in 1 short contact:

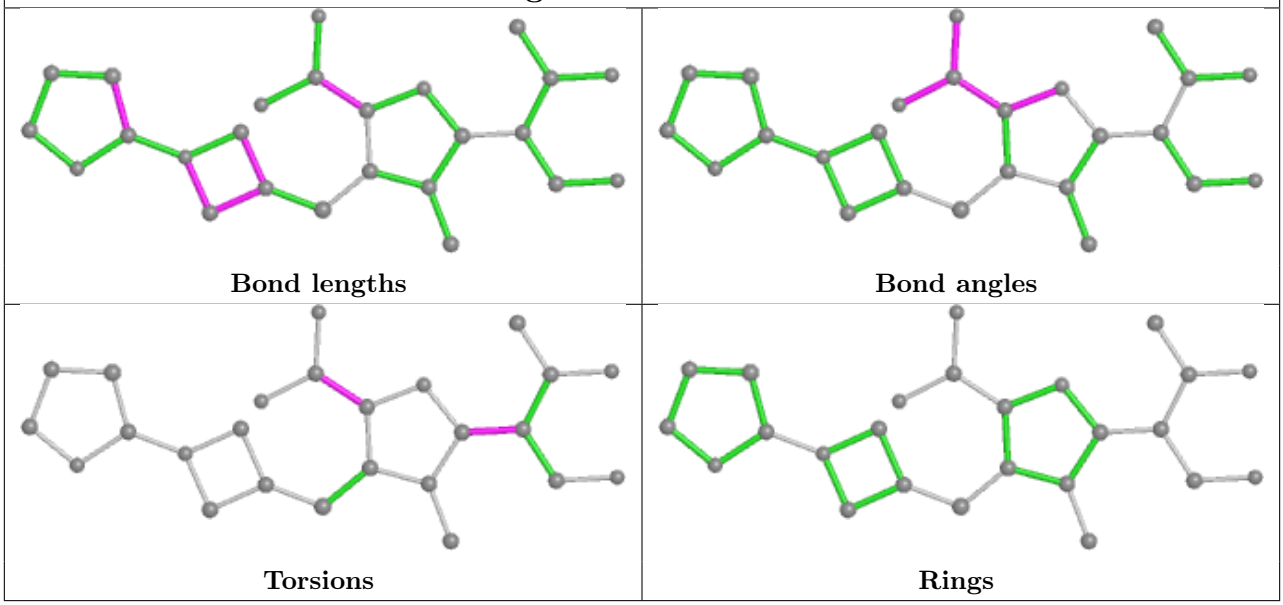
Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	D	701	TEB	1	0

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 TEB D 701



Ligand TEB B 701



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.