



wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 17, 2021 – 02:48 AM EDT

PDB ID : 1MTO
Title : Crystal structure of a Phosphofructokinase mutant from *Bacillus stearothermophilus* bound with fructose-6-phosphate
Authors : Riley-Lovingshimer, M.R.; Ronning, D.R.; Sacchettini, J.C.; Reinhart, G.D.
Deposited on : 2002-09-21
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

A user guide is available at

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

with specific help available everywhere you see the ⓘ symbol.

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

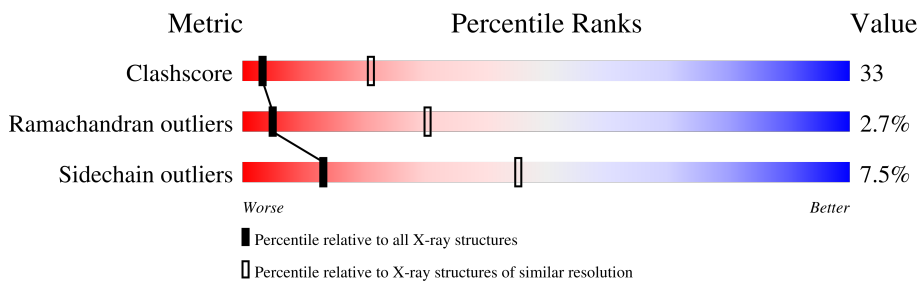
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 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 ≥ 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	319	48% 45% 8%
1	B	319	50% 46% .
1	C	319	46% 50% . .
1	D	319	46% 48% 6%
1	E	319	40% 51% 8%
1	F	319	46% 50% 5%
1	G	319	41% 55% .
1	H	319	46% 50% .

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 19328 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 6-phosphofructokinase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	319	2400	1499	436	457	8	0	0	0
1	B	319	2400	1499	436	457	8	0	0	0
1	C	319	2400	1499	436	457	8	0	0	0
1	D	319	2400	1499	436	457	8	0	0	0
1	E	319	2400	1499	436	457	8	0	0	0
1	F	319	2400	1499	436	457	8	0	0	0
1	G	319	2400	1499	436	457	8	0	0	0
1	H	319	2400	1499	436	457	8	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

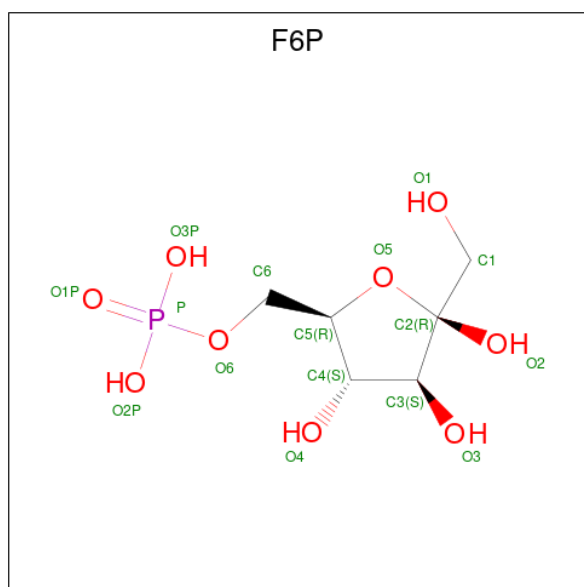
Chain	Residue	Modelled	Actual	Comment	Reference
A	164	TRP	TYR	engineered mutation	UNP P00512
A	179	TYR	TRP	engineered mutation	UNP P00512
B	164	TRP	TYR	engineered mutation	UNP P00512
B	179	TYR	TRP	engineered mutation	UNP P00512
C	164	TRP	TYR	engineered mutation	UNP P00512
C	179	TYR	TRP	engineered mutation	UNP P00512
D	164	TRP	TYR	engineered mutation	UNP P00512
D	179	TYR	TRP	engineered mutation	UNP P00512
E	164	TRP	TYR	engineered mutation	UNP P00512
E	179	TYR	TRP	engineered mutation	UNP P00512
F	164	TRP	TYR	engineered mutation	UNP P00512
F	179	TYR	TRP	engineered mutation	UNP P00512
G	164	TRP	TYR	engineered mutation	UNP P00512

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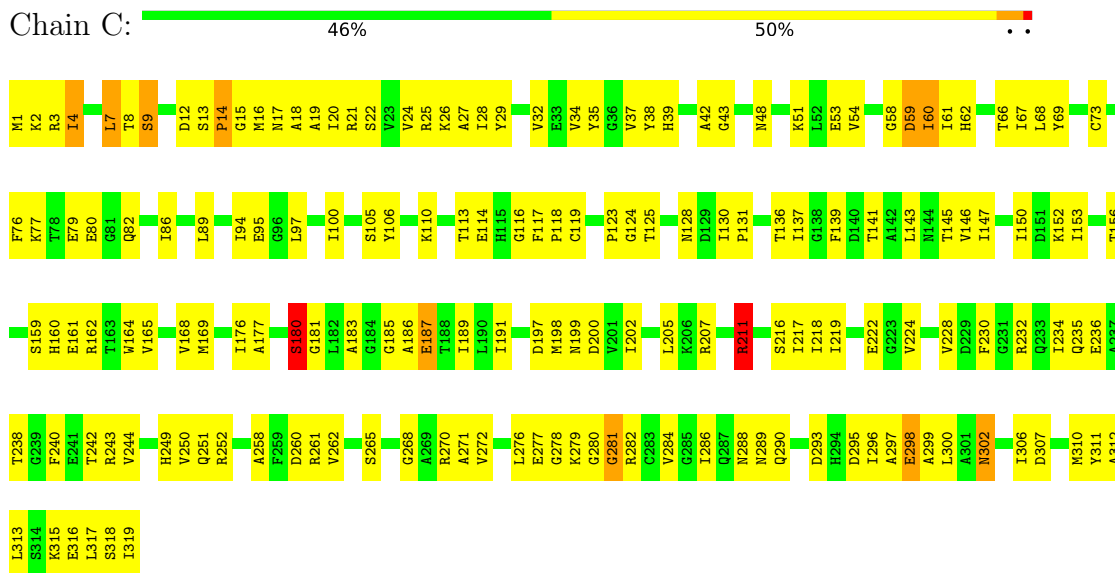
Chain	Residue	Modelled	Actual	Comment	Reference
G	179	TYR	TRP	engineered mutation	UNP P00512
H	164	TRP	TYR	engineered mutation	UNP P00512
H	179	TYR	TRP	engineered mutation	UNP P00512

- Molecule 2 is 6-O-phosphono-beta-D-fructofuranose (three-letter code: F6P) (formula: C₆H₁₃O₉P).

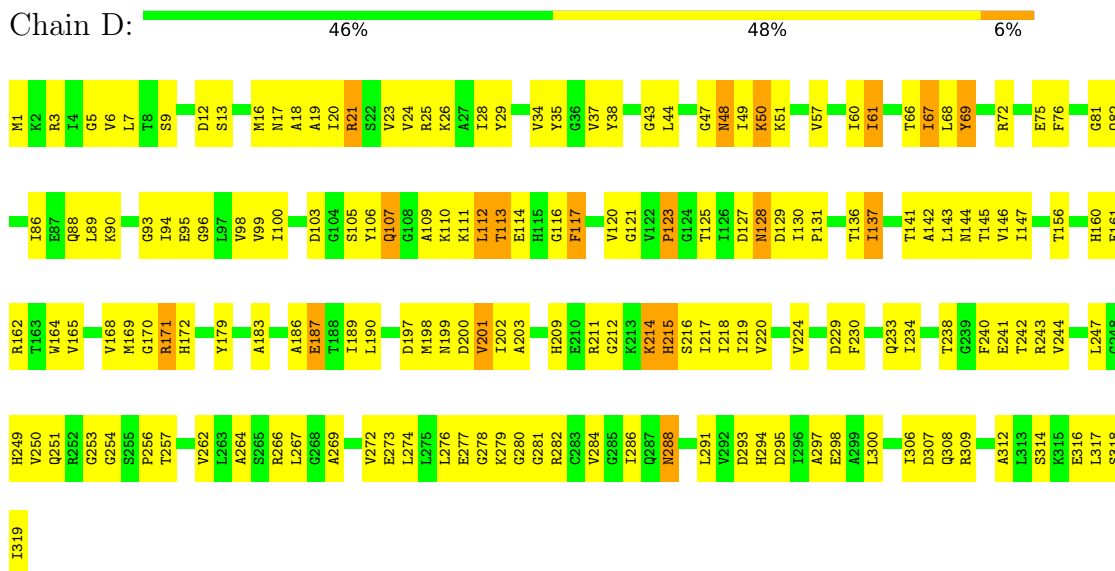


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	O	P		
2	A	1	Total	C	O	P	0	0
			16	6	9	1		
2	B	1	Total	C	O	P	0	0
			16	6	9	1		
2	C	1	Total	C	O	P	0	0
			16	6	9	1		
2	D	1	Total	C	O	P	0	0
			16	6	9	1		
2	E	1	Total	C	O	P	0	0
			16	6	9	1		
2	F	1	Total	C	O	P	0	0
			16	6	9	1		
2	G	1	Total	C	O	P	0	0
			16	6	9	1		
2	H	1	Total	C	O	P	0	0
			16	6	9	1		

- Molecule 1: 6-phosphofructokinase



- Molecule 1: 6-phosphofructokinase



- Molecule 1: 6-phosphofructokinase



4 Data and refinement statistics

Xtrriage (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, α , β , γ	110.68Å 106.87Å 119.59Å 90.00° 113.98° 90.00°	Depositor
Resolution (Å)	29.84 – 3.20	Depositor
% Data completeness (in resolution range)	86.7 (29.84-3.20)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.180 , 0.280	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	19328	wwPDB-VP
Average B, all atoms (Å ²)	31.0	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: F6P

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	0.35	0/2436	0.60	0/3282
1	B	0.38	0/2436	0.63	1/3282 (0.0%)
1	C	0.35	0/2436	0.60	0/3282
1	D	0.38	0/2436	0.62	0/3282
1	E	0.37	0/2436	0.62	0/3282
1	F	0.37	0/2436	0.61	0/3282
1	G	0.39	0/2436	0.62	0/3282
1	H	0.37	0/2436	0.62	0/3282
All	All	0.37	0/19488	0.62	1/26256 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	B	7	LEU	CA-CB-CG	5.28	127.44	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	2400	0	2417	172	0
1	B	2400	0	2417	152	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	2400	0	2417	151	0
1	D	2400	0	2417	170	0
1	E	2400	0	2417	184	0
1	F	2400	0	2417	180	0
1	G	2400	0	2417	180	0
1	H	2400	0	2417	169	0
2	A	16	0	11	1	0
2	B	16	0	11	0	0
2	C	16	0	11	1	0
2	D	16	0	11	0	0
2	E	16	0	11	0	0
2	F	16	0	11	2	0
2	G	16	0	11	1	0
2	H	16	0	11	3	0
All	All	19328	0	19424	1274	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 33.

The worst 5 of 1274 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:282:ARG:HH12	1:A:293:ASP:HB3	1.04	1.11
1:H:171:ARG:HG3	1:H:172:HIS:H	1.19	1.06
1:F:14:PRO:HG2	1:F:141:THR:HG21	1.38	1.03
1:A:24:VAL:HG21	1:A:57:VAL:HG11	1.45	0.98
1:D:123:PRO:HB2	1:D:136:THR:HG22	1.45	0.96

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	317/319 (99%)	275 (87%)	34 (11%)	8 (2%)	5	32
1	B	317/319 (99%)	263 (83%)	47 (15%)	7 (2%)	6	35
1	C	317/319 (99%)	254 (80%)	52 (16%)	11 (4%)	3	24
1	D	317/319 (99%)	268 (84%)	37 (12%)	12 (4%)	3	22
1	E	317/319 (99%)	270 (85%)	35 (11%)	12 (4%)	3	22
1	F	317/319 (99%)	281 (89%)	34 (11%)	2 (1%)	25	64
1	G	317/319 (99%)	263 (83%)	46 (14%)	8 (2%)	5	32
1	H	317/319 (99%)	261 (82%)	48 (15%)	8 (2%)	5	32
All	All	2536/2552 (99%)	2135 (84%)	333 (13%)	68 (3%)	5	30

5 of 68 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	193	GLU
1	C	279	LYS
1	G	211	ARG
1	H	171	ARG
1	H	213	LYS

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	247/247 (100%)	221 (90%)	26 (10%)	7	28
1	B	247/247 (100%)	231 (94%)	16 (6%)	17	51
1	C	247/247 (100%)	227 (92%)	20 (8%)	11	42
1	D	247/247 (100%)	229 (93%)	18 (7%)	14	46
1	E	247/247 (100%)	225 (91%)	22 (9%)	9	35
1	F	247/247 (100%)	230 (93%)	17 (7%)	15	49
1	G	247/247 (100%)	237 (96%)	10 (4%)	31	66
1	H	247/247 (100%)	228 (92%)	19 (8%)	13	44

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	1976/1976 (100%)	1828 (92%)	148 (8%)	13 45

5 of 148 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	218	ILE
1	H	229	ASP
1	G	2	LYS
1	H	7	LEU
1	C	80	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 65 such sidechains are listed below:

Mol	Chain	Res	Type
1	G	302	ASN
1	H	48	ASN
1	D	39	HIS
1	C	302	ASN
1	H	62	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](#)

8 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	F6P	D	1003	-	15,16,16	1.09	1 (6%)	17,25,25	1.02	1 (5%)
2	F6P	F	1005	-	15,16,16	1.09	1 (6%)	17,25,25	1.08	0
2	F6P	C	1004	-	15,16,16	1.04	0	17,25,25	1.04	0
2	F6P	B	1001	-	15,16,16	1.08	0	17,25,25	1.03	1 (5%)
2	F6P	H	1007	-	15,16,16	0.98	0	17,25,25	1.15	1 (5%)
2	F6P	G	1008	-	15,16,16	1.04	1 (6%)	17,25,25	1.05	1 (5%)
2	F6P	A	1002	-	15,16,16	1.07	0	17,25,25	0.94	0
2	F6P	E	1006	-	15,16,16	1.13	1 (6%)	17,25,25	1.06	1 (5%)

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	F6P	D	1003	-	-	2/9/28/28	0/1/1/1
2	F6P	F	1005	-	-	0/9/28/28	0/1/1/1
2	F6P	C	1004	-	-	0/9/28/28	0/1/1/1
2	F6P	B	1001	-	-	2/9/28/28	0/1/1/1
2	F6P	H	1007	-	-	3/9/28/28	0/1/1/1
2	F6P	G	1008	-	-	3/9/28/28	0/1/1/1
2	F6P	A	1002	-	-	1/9/28/28	0/1/1/1
2	F6P	E	1006	-	-	3/9/28/28	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	1003	F6P	O5-C2	-2.70	1.39	1.43
2	G	1008	F6P	O5-C2	-2.51	1.39	1.43
2	F	1005	F6P	O5-C2	-2.43	1.39	1.43
2	E	1006	F6P	C1-C2	2.38	1.56	1.52

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	H	1007	F6P	P-O6-C6	2.69	125.71	118.30
2	D	1003	F6P	P-O6-C6	2.37	124.83	118.30
2	E	1006	F6P	P-O6-C6	2.26	124.52	118.30
2	G	1008	F6P	P-O6-C6	2.11	124.11	118.30
2	B	1001	F6P	P-O6-C6	2.02	123.87	118.30

There are no chirality outliers.

5 of 14 torsion outliers are listed below:

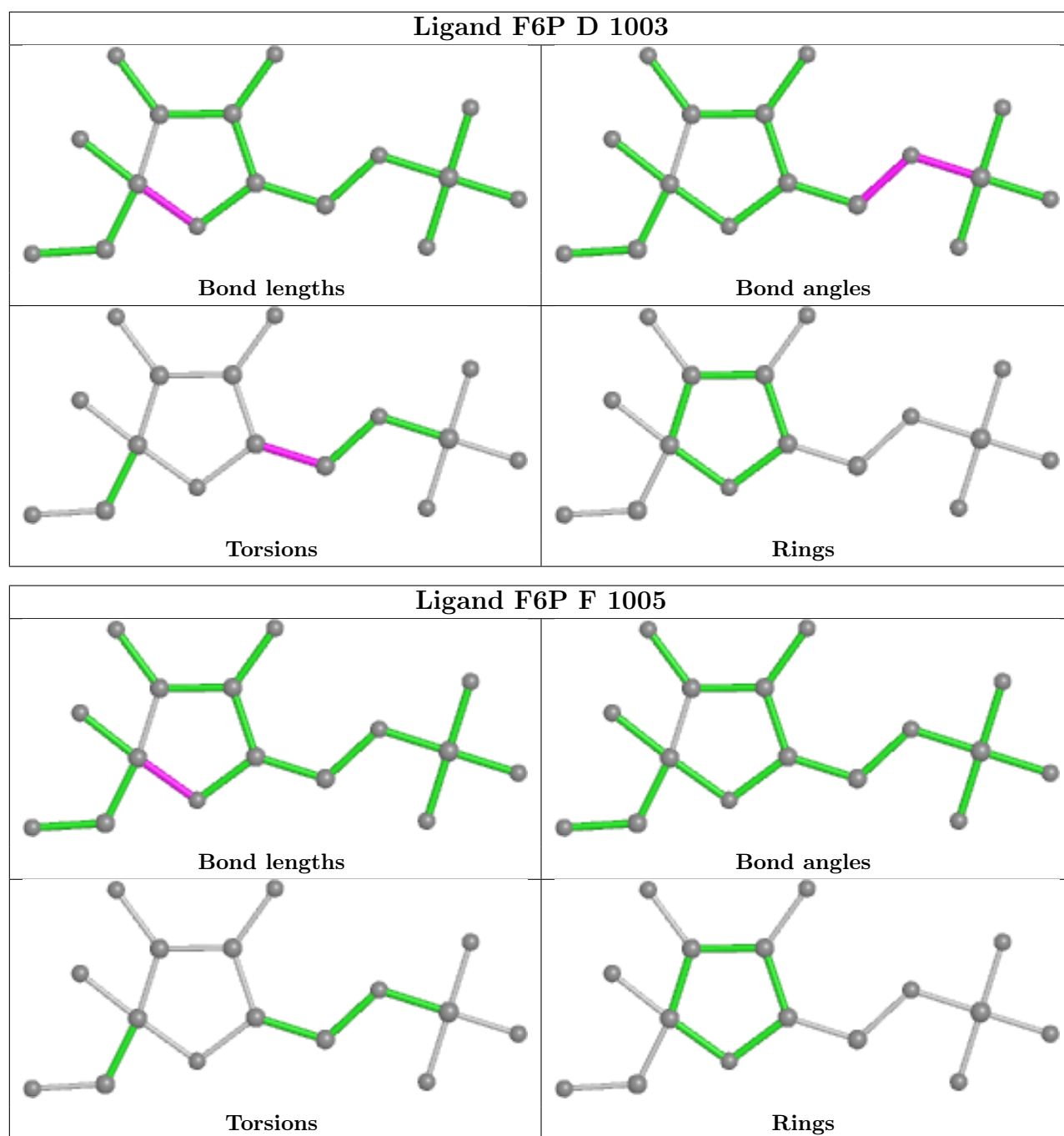
Mol	Chain	Res	Type	Atoms
2	B	1001	F6P	C4-C5-C6-O6
2	B	1001	F6P	O5-C5-C6-O6
2	D	1003	F6P	C4-C5-C6-O6
2	D	1003	F6P	O5-C5-C6-O6
2	E	1006	F6P	C4-C5-C6-O6

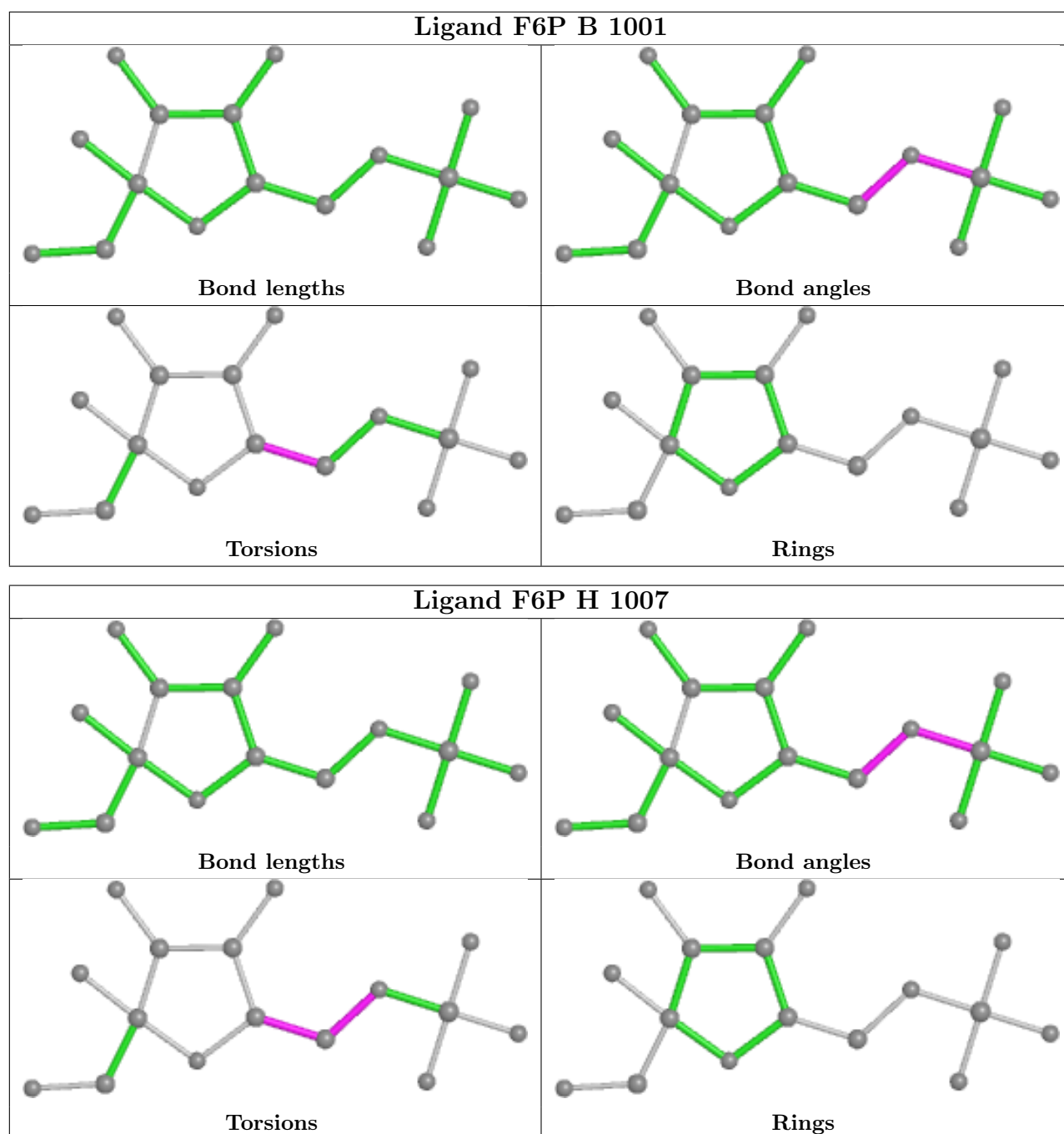
There are no ring outliers.

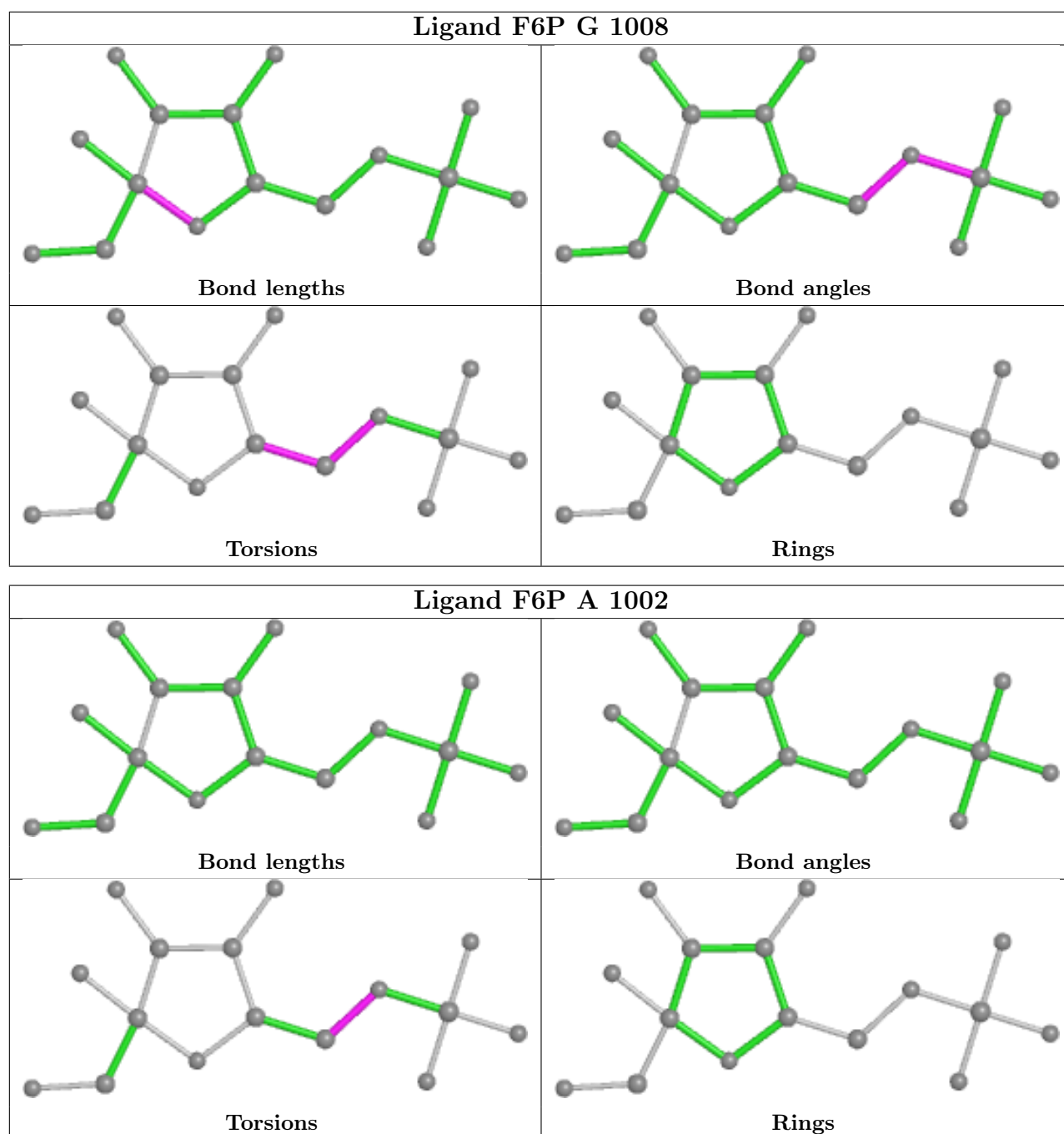
5 monomers are involved in 8 short contacts:

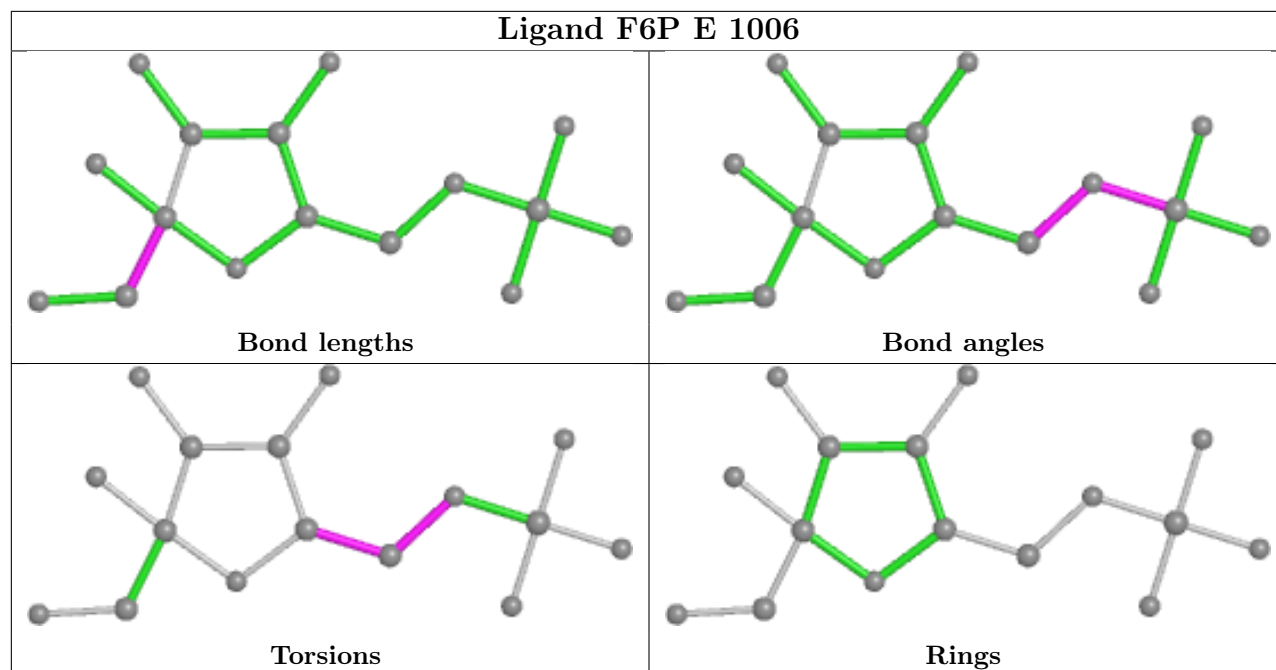
Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	F	1005	F6P	2	0
2	C	1004	F6P	1	0
2	H	1007	F6P	3	0
2	G	1008	F6P	1	0
2	A	1002	F6P	1	0

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.









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

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.