



wwPDB X-ray Structure Validation Summary Report ⓘ

Jul 14, 2016 – 07:27 PM EDT

PDB ID : 4Y5R
Title : Crystal Structure of a T67A MauG/pre-Methylamine Dehydrogenase Complex
Authors : Li, C.; Wilmot, C.M.
Deposited on : 2015-02-11
Resolution : 2.80 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
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

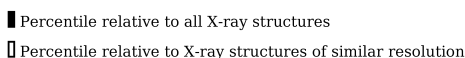
The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20027790
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20027790

i

X-RAY DIFFRACTION

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))
R_{free}	91344	2393 (2.80-2.80)
Clashscore	102246	2827 (2.80-2.80)
Ramachandran outliers	100387	2782 (2.80-2.80)
Sidechain outliers	100360	2784 (2.80-2.80)
RSRZ outliers	91569	2404 (2.80-2.80)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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 $\leq 5\%$. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain	
1	A	355	<div><div></div><div></div><div></div></div> 89%	11%
1	B	355	<div><div></div><div></div><div></div></div> 90%	10%
2	C	125	<div><div></div><div></div><div></div></div> 86%	14%
2	E	125	<div><div></div><div></div><div></div></div> 85%	15%
3	D	376	<div><div></div><div></div><div></div></div> 87%	13%
3	F	376	<div><div></div><div></div><div></div></div> 91%	9%

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 13430 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 Methylamine utilization protein MauG.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	354	Total	C	N	O	S	0	1	0
			2738	1710	491	526	11			
1	B	355	Total	C	N	O	S	0	0	0
			2741	1711	491	528	11			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	67	ALA	THR	engineered mutation	UNP Q51658
B	67	ALA	THR	engineered mutation	UNP Q51658

- Molecule 2 is a protein called Methylamine dehydrogenase light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	125	Total	C	N	O	S	0	1	0
			957	592	161	190	14			
2	E	125	Total	C	N	O	S	0	3	0
			963	596	161	190	16			

- Molecule 3 is a protein called Methylamine dehydrogenase heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	376	Total	C	N	O	S	0	1	0
			2925	1854	502	560	9			
3	F	376	Total	C	N	O	S	0	1	0
			2926	1855	502	560	9			

- Molecule 4 is CALCIUM ION (three-letter code: CA) (formula: Ca).

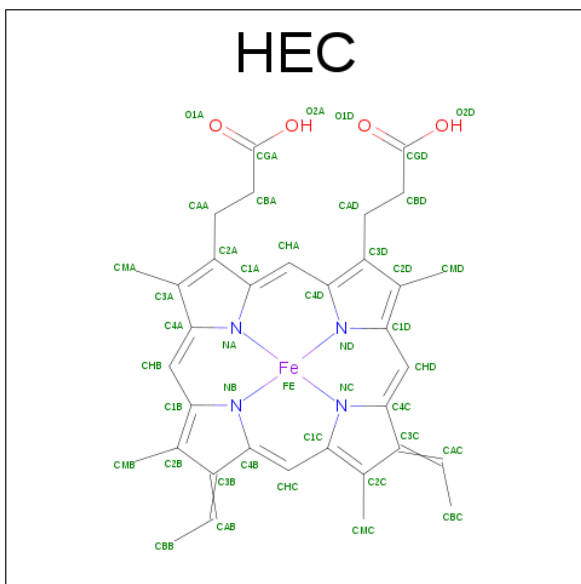
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Ca	0	0
			1	1		

Continued on next page...

Continued from previous page...

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total Ca 1 1	0	0

- Molecule 5 is HEME C (three-letter code: HEC) (formula: $\text{C}_{34}\text{H}_{34}\text{FeN}_4\text{O}_4$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
5	A	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
5	A	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
5	B	1	Total 43	C 34	Fe 1	N 4	O 4	0	0
5	B	1	Total 43	C 34	Fe 1	N 4	O 4	0	0

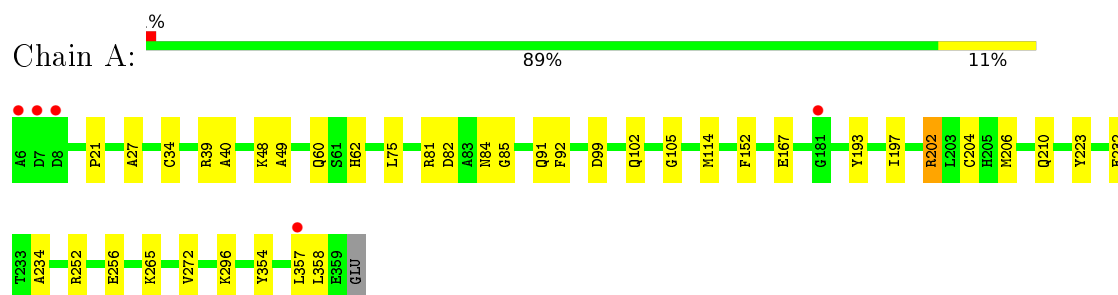
- Molecule 6 is water.

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

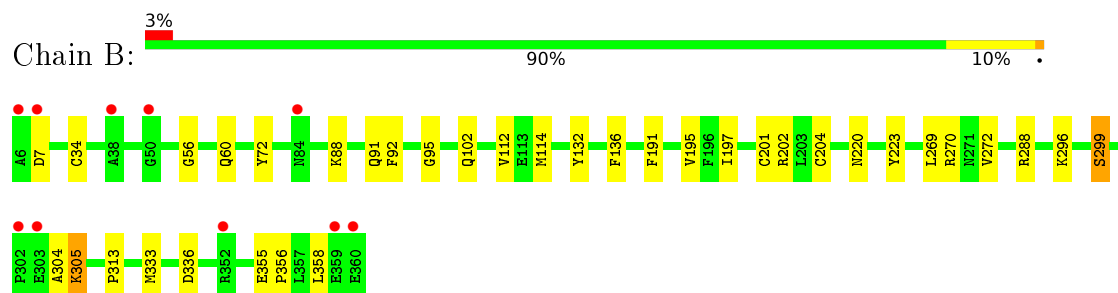
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ($\text{RSRZ} > 2$). 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.

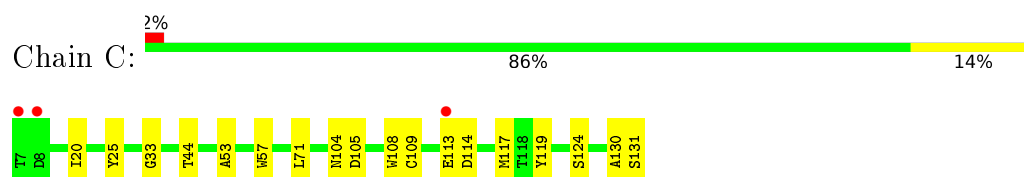
- Molecule 1: Methylamine utilization protein MauG



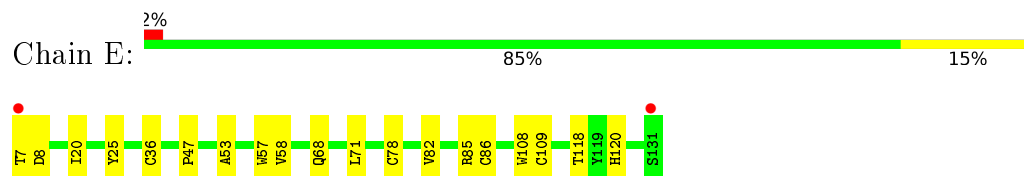
- Molecule 1: Methylamine utilization protein MauG



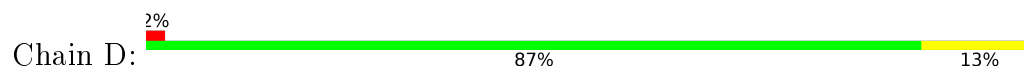
- Molecule 2: Methylamine dehydrogenase light chain

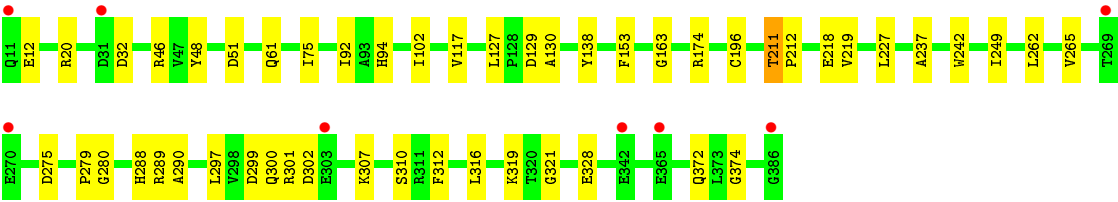


- Molecule 2: Methylamine dehydrogenase light chain

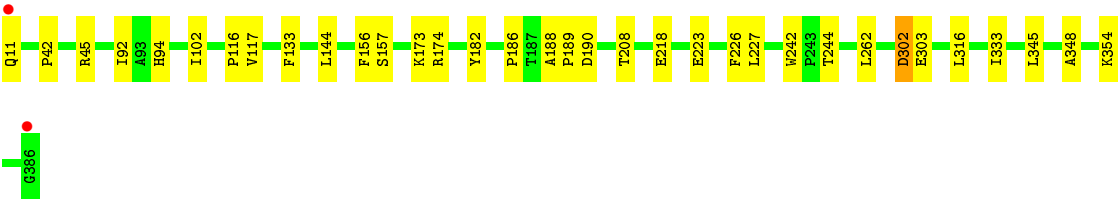
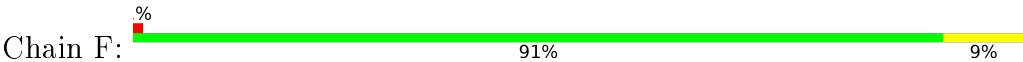


- Molecule 3: Methylamine dehydrogenase heavy chain





• Molecule 3: Methylamine dehydrogenase heavy chain



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	55.53Å 83.52Å 107.78Å 109.94° 91.54° 105.78°	Depositor
Resolution (Å)	29.61 – 2.80 29.66 – 2.80	Depositor EDS
% Data completeness (in resolution range)	98.2 (29.61-2.80) 85.7 (29.66-2.80)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.30 (at 2.80Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.193 , 0.256 0.197 , 0.255	Depositor DCC
R_{free} test set	2135 reflections (5.36%)	DCC
Wilson B-factor (Å ²)	46.9	Xtriage
Anisotropy	0.048	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 35.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	13430	wwPDB-VP
Average B, all atoms (Å ²)	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.36% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

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: CA, OAF, HEC

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	0.53	0/2805	0.71	1/3806 (0.0%)
1	B	0.55	0/2805	0.73	0/3806
2	C	0.55	0/969	0.73	0/1323
2	E	0.59	0/981	0.78	1/1340 (0.1%)
3	D	0.54	0/3006	0.72	0/4096
3	F	0.56	0/3006	0.74	0/4096
All	All	0.55	0/13572	0.73	2/18467 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	39	ARG	NE-CZ-NH1	5.33	122.97	120.30
2	E	8	ASP	CB-CG-OD1	5.09	122.88	118.30

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	2738	0	2616	24	0
1	B	2741	0	2614	26	0
2	C	957	0	863	15	0

Continued on next page...

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	E	963	0	871	16	0
3	D	2925	0	2808	27	0
3	F	2926	0	2812	13	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	A	86	0	62	10	0
5	B	86	0	60	13	0
6	A	4	0	0	0	0
6	B	2	0	0	0	0
All	All	13430	0	12706	115	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 4.

The worst 5 of 115 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:204:CYS:SG	5:B:403:HEC:CAC	2.22	1.27
1:B:34:CYS:SG	5:B:402:HEC:CAC	2.30	1.19
1:A:204:CYS:SG	5:A:403:HEC:CAC	2.32	1.16
1:A:204:CYS:SG	5:A:403:HEC:HBC3	1.87	1.14
1:B:204:CYS:SG	5:B:403:HEC:CBC	2.37	1.12

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	353/355 (99%)	336 (95%)	17 (5%)	0	100	100
1	B	353/355 (99%)	334 (95%)	19 (5%)	0	100	100

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	C	123/125 (98%)	119 (97%)	4 (3%)	0	100	100
2	E	125/125 (100%)	120 (96%)	5 (4%)	0	100	100
3	D	375/376 (100%)	356 (95%)	17 (4%)	2 (0%)	34	69
3	F	375/376 (100%)	357 (95%)	17 (4%)	1 (0%)	46	79
All	All	1704/1712 (100%)	1622 (95%)	79 (5%)	3 (0%)	52	84

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	D	102	ILE
3	D	32	ASP
3	F	102	ILE

5.3.2 Protein sidechains ⓘ

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	276/276 (100%)	266 (96%)	10 (4%)	42	76
1	B	276/276 (100%)	267 (97%)	9 (3%)	45	79
2	C	105/104 (101%)	103 (98%)	2 (2%)	65	91
2	E	107/104 (103%)	103 (96%)	4 (4%)	41	76
3	D	305/304 (100%)	294 (96%)	11 (4%)	42	76
3	F	305/304 (100%)	294 (96%)	11 (4%)	42	76
All	All	1374/1368 (100%)	1327 (97%)	47 (3%)	44	78

5 of 47 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	D	92	ILE
3	D	211	THR
3	F	262	LEU
3	D	117	VAL

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
3	D	262	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	210	GLN
3	D	94	HIS
3	F	60	GLN
1	B	163	GLN
3	F	14	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

2 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
2	0AF	C	57	2	12,16,17	1.92	2 (16%)	11,22,24	1.15	1 (9%)
2	0AF	E	57	2	12,16,17	1.93	2 (16%)	11,22,24	1.21	1 (9%)

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	0AF	C	57	2	-	0/3/6/8	0/2/2/2
2	0AF	E	57	2	-	0/3/6/8	0/2/2/2

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	57	0AF	CE3-CD2	-2.30	1.37	1.42
2	E	57	0AF	CZ3-CE3	2.20	1.41	1.36
2	E	57	0AF	CZ2-CE2	5.33	1.50	1.42
2	C	57	0AF	CZ2-CE2	5.63	1.50	1.42

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	57	0AF	O-C-CA	-2.47	119.11	125.72
2	E	57	0AF	O-C-CA	-2.22	119.77	125.72

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 10 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	57	0AF	5	0
2	E	57	0AF	5	0

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 6 ligands modelled in this entry, 2 are monoatomic - leaving 4 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	$\# Z > 2$
5	HEC	A	402	1	24,50,50	2.47	11 (45%)	19,82,82	3.04	9 (47%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
5	HEC	A	403	1	24,50,50	2.46	11 (45%)	19,82,82	2.93	6 (31%)
5	HEC	B	402	1	24,50,50	2.74	9 (37%)	19,82,82	2.84	7 (36%)
5	HEC	B	403	1	24,50,50	2.67	9 (37%)	19,82,82	2.98	6 (31%)

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
5	HEC	A	402	1	-	0/6/54/54	0/0/8/8
5	HEC	A	403	1	-	0/6/54/54	0/0/8/8
5	HEC	B	402	1	-	0/6/54/54	0/0/8/8
5	HEC	B	403	1	-	0/6/54/54	0/0/8/8

The worst 5 of 40 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	A	403	HEC	C4A-NA	-3.49	1.32	1.36
5	B	403	HEC	C1A-NA	-3.18	1.32	1.36
5	B	402	HEC	C4A-NA	-2.56	1.33	1.36
5	B	403	HEC	C4C-NC	-2.49	1.33	1.36
5	A	403	HEC	C4C-NC	-2.33	1.33	1.36

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	402	HEC	CBD-CAD-C3D	-8.61	97.35	112.49
5	A	403	HEC	CBD-CAD-C3D	-8.00	98.43	112.49
5	B	403	HEC	CBD-CAD-C3D	-7.14	99.93	112.49
5	B	402	HEC	CBD-CAD-C3D	-6.57	100.94	112.49
5	B	403	HEC	CBC-CAC-C3C	-4.10	118.38	127.34

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 23 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	402	HEC	4	0

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	403	HEC	6	0
5	B	402	HEC	6	0
5	B	403	HEC	7	0

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](#)

In the following table, the column labelled ‘#RSRZ> 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95th percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q< 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
1	A	354/355 (99%)	-0.04	5 (1%) 78 69	39, 53, 73, 108	0
1	B	355/355 (100%)	-0.10	10 (2%) 56 44	35, 51, 76, 111	0
2	C	124/125 (99%)	-0.23	3 (2%) 62 50	37, 48, 67, 97	0
2	E	124/125 (99%)	-0.34	2 (1%) 74 66	31, 43, 56, 106	0
3	D	376/376 (100%)	-0.12	8 (2%) 67 56	34, 51, 78, 104	0
3	F	376/376 (100%)	-0.29	2 (0%) 91 88	30, 43, 63, 113	0
All	All	1709/1712 (99%)	-0.16	30 (1%) 71 61	30, 49, 74, 113	0

The worst 5 of 30 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	C	7	THR	4.9
3	D	386	GLY	4.6
3	D	11	GLN	4.5
2	E	131	SER	4.3
3	F	11	GLN	4.3

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

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q< 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors(Å ²)	Q<0.9
2	0AF	C	57	15/16	0.91	0.19	-	52,56,60,60	0
2	0AF	E	57	15/16	0.94	0.20	-	42,45,55,65	0

6.3 Carbohydrates [i](#)

There are no carbohydrates in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors(\AA^2)	Q<0.9
5	HEC	B	402	43/43	0.95	0.21	1.08	39,45,49,51	0
5	HEC	B	403	43/43	0.97	0.18	0.62	30,31,33,39	0
4	CA	B	401	1/1	0.98	0.16	0.61	40,40,40,40	0
5	HEC	A	402	43/43	0.95	0.19	0.26	39,45,49,50	0
5	HEC	A	403	43/43	0.97	0.20	0.15	37,43,46,48	0
4	CA	A	401	1/1	0.98	0.15	-1.33	32,32,32,32	0

6.5 Other polymers [i](#)

There are no such residues in this entry.