



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 19, 2016 – 07:00 PM GMT

PDB ID : 4PA0
Title : Omecamtiv Mercarbil binding site on the Human Beta-Cardiac Myosin Motor Domain
Authors : Winkelmann, D.A.; Miller, M.T.; Stock, A.M.
Deposited on : 2014-04-06
Resolution : 2.25 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-20026982
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-20026982

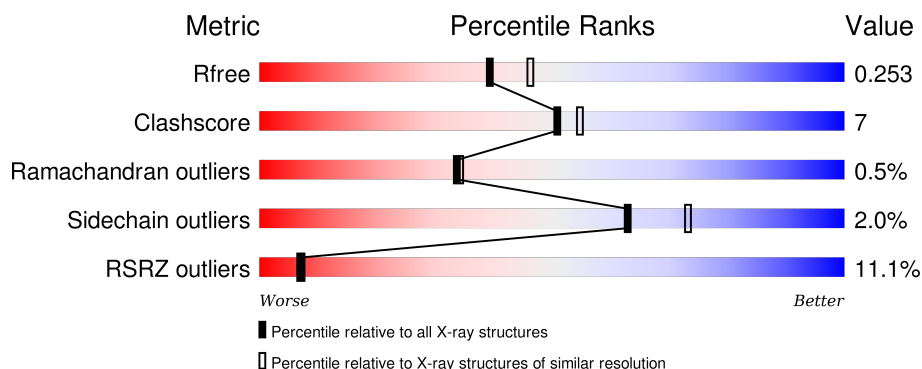
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.25 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))
R_{free}	91344	1640 (2.28-2.24)
Clashscore	102246	1095 (2.26-2.26)
Ramachandran outliers	100387	1063 (2.26-2.26)
Sidechain outliers	100360	1063 (2.26-2.26)
RSRZ outliers	91569	1647 (2.28-2.24)

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	1024	<div> <div>5%</div> <div>80%</div> <div>15%</div> <div>• 5%</div> </div>
1	B	1024	<div> <div>16%</div> <div>76%</div> <div>13%</div> <div>• 10%</div> </div>

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	2OW	A	1101	-	-	X	X
2	2OW	B	1101	-	-	X	X
3	GOL	B	1103	-	-	-	X
3	GOL	B	1104	-	-	-	X

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 14977 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 Myosin-7, Green fluorescent protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	975	Total	C	N	O	S	0	0	0
			7601	4857	1291	1415	38			
1	B	921	Total	C	N	O	S	0	0	0
			6994	4449	1192	1316	37			

There are 34 discrepancies between the modelled and reference sequences:

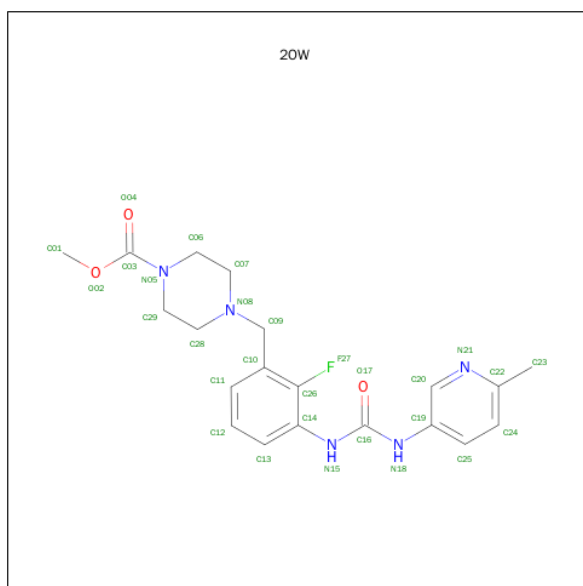
Chain	Residue	Modelled	Actual	Comment	Reference
A	788	THR	-	linker	UNP P12883
A	789	GLN	-	linker	UNP P12883
A	790	ALA	-	linker	UNP P12883
A	791	ALA	-	linker	UNP P12883
A	853	CRO	SER	chromophore	UNP P42212
A	853	CRO	TYR	chromophore	UNP P42212
A	853	CRO	GLY	chromophore	UNP P42212
A	867	ARG	GLN	engineered mutation	UNP P42212
A	950	ALA	VAL	engineered mutation	UNP P42212
A	954	THR	ILE	engineered mutation	UNP P42212
A	962	GLY	SER	engineered mutation	UNP P42212
A	977	ASN	ASP	engineered mutation	UNP P42212
A	1022	TYR	-	SEE REMARK 999	UNP P42212
A	1023	LYS	-	SEE REMARK 999	UNP P42212
A	1024	ASP	-	SEE REMARK 999	UNP P42212
A	1025	HIS	-	SEE REMARK 999	UNP P42212
A	1026	ASP	-	SEE REMARK 999	UNP P42212
B	788	THR	-	linker	UNP P12883
B	789	GLN	-	linker	UNP P12883
B	790	ALA	-	linker	UNP P12883
B	791	ALA	-	linker	UNP P12883
B	853	CRO	SER	chromophore	UNP P42212
B	853	CRO	TYR	chromophore	UNP P42212
B	853	CRO	GLY	chromophore	UNP P42212
B	867	ARG	GLN	engineered mutation	UNP P42212

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Chain	Residue	Modelled	Actual	Comment	Reference
B	950	ALA	VAL	engineered mutation	UNP P42212
B	954	THR	ILE	engineered mutation	UNP P42212
B	962	GLY	SER	engineered mutation	UNP P42212
B	977	ASN	ASP	engineered mutation	UNP P42212
B	1022	TYR	-	SEE REMARK 999	UNP P42212
B	1023	LYS	-	SEE REMARK 999	UNP P42212
B	1024	ASP	-	SEE REMARK 999	UNP P42212
B	1025	HIS	-	SEE REMARK 999	UNP P42212
B	1026	ASP	-	SEE REMARK 999	UNP P42212

- Molecule 2 is methyl 4-(2-fluoro-3-[(6-methylpyridin-3-yl)carbamoyl]amino}benzyl)piperazine-1-carboxylate (three-letter code: 2OW) (formula: C₂₀H₂₄FN₅O₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	F	N	O	0	0
			29	20	1	5	3		
2	B	1	Total	C	F	N	O	0	0
			29	20	1	5	3		

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula: C₃H₈O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	B	1	Total	C	O	0	0
			6	3	3		
3	B	1	Total	C	O	0	0
			6	3	3		
3	B	1	Total	C	O	0	0
			6	3	3		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	142	Total	O	0	0
			142	142		
4	B	164	Total	O	0	0
			164	164		

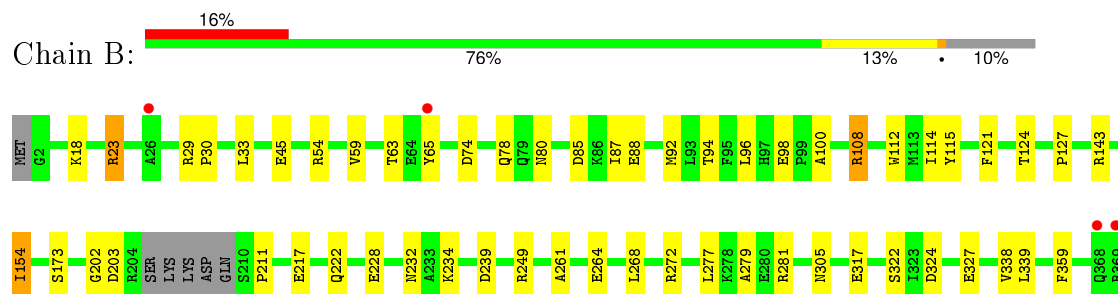
3 Residue-property plots

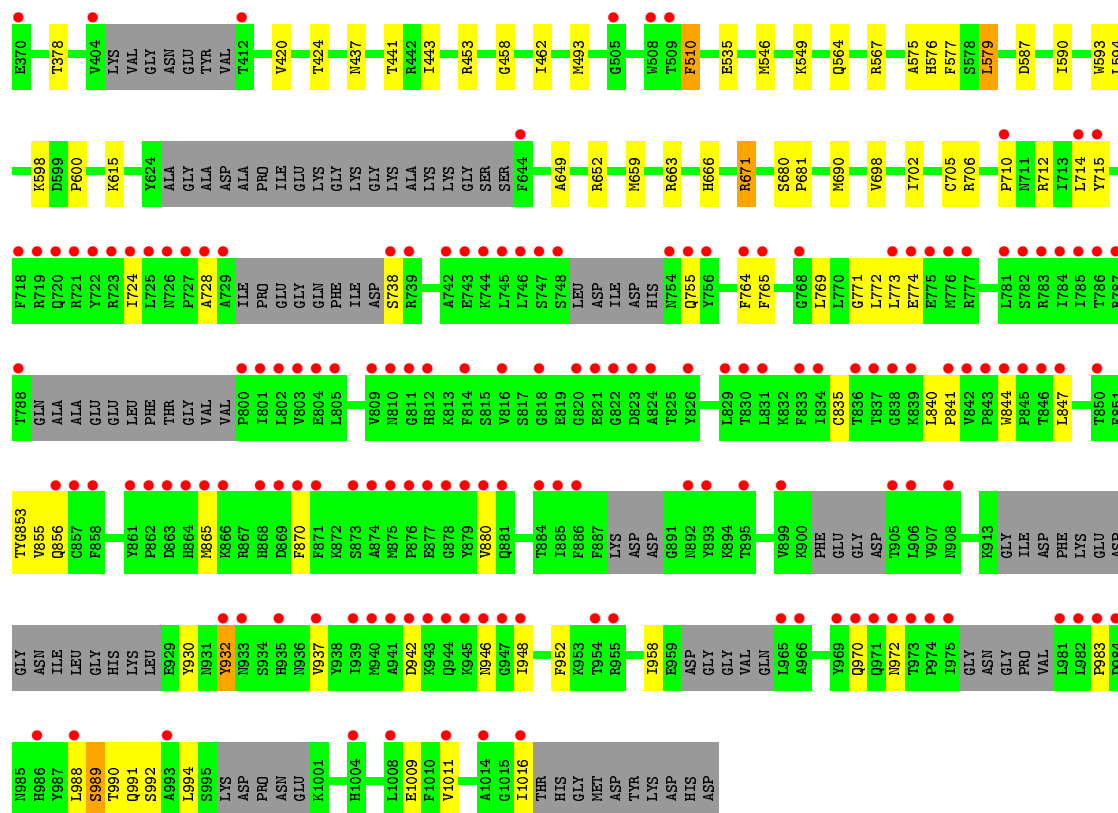
These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according 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 ($RSRZ > 2$). 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: Myosin-7, Green fluorescent protein



- Molecule 1: Myosin-7, Green fluorescent protein





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	100.17Å 88.92Å 137.79Å 90.00° 93.92° 90.00°	Depositor
Resolution (Å)	45.96 – 2.25 45.96 – 2.25	Depositor EDS
% Data completeness (in resolution range)	93.2 (45.96-2.25) 84.5 (45.96-2.25)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.66 (at 2.24Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.9_1692)	Depositor
R, R_{free}	0.201 , 0.246 0.216 , 0.253	Depositor DCC
R_{free} test set	5386 reflections (5.85%)	DCC
Wilson B-factor (Å ²)	26.1	Xtriage
Anisotropy	0.610	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 54.5	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	2 of 107030 reflections (0.002%)	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	14977	wwPDB-VP
Average B, all atoms (Å ²)	45.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 12.32% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: GOL, CRO, 2OW

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	0/7744	0.64	2/10478 (0.0%)
1	B	0.53	0/7119	0.65	3/9646 (0.0%)
All	All	0.53	0/14863	0.64	5/20124 (0.0%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	143	ARG	NE-CZ-NH2	-7.73	116.44	120.30
1	B	108	ARG	NE-CZ-NH2	-6.82	116.89	120.30
1	B	671	ARG	NE-CZ-NH2	-5.82	117.39	120.30
1	B	202	GLY	N-CA-C	-5.79	98.62	113.10
1	A	202	GLY	N-CA-C	-5.04	100.49	113.10

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	7601	0	7315	97	0
1	B	6994	0	6481	97	0
2	A	29	0	24	10	0
2	B	29	0	24	12	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	B	18	0	24	3	0
4	A	142	0	0	8	0
4	B	164	0	0	11	0
All	All	14977	0	13868	198	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 7.

The worst 5 of 198 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:705:CYS:HB2	2:B:1101:2OW:H5	1.46	0.94
1:B:63:THR:HG22	1:B:65:TYR:H	1.36	0.90
1:A:446:THR:O	4:A:1234:HOH:O	1.91	0.89
1:A:63:THR:HG22	1:A:65:TYR:H	1.42	0.84
1:B:702:ILE:HA	2:B:1101:2OW:H4	1.60	0.82

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	960/1024 (94%)	907 (94%)	48 (5%)	5 (0%)	34	34
1	B	892/1024 (87%)	858 (96%)	29 (3%)	5 (1%)	30	30
All	All	1852/2048 (90%)	1765 (95%)	77 (4%)	10 (0%)	34	34

5 of 10 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	568	ASN

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Mol	Chain	Res	Type
1	A	999	ASN
1	B	203	ASP
1	B	728	ALA
1	B	946	ASN

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	785/882 (89%)	770 (98%)	15 (2%)	65	75
1	B	690/882 (78%)	676 (98%)	14 (2%)	63	73
All	All	1475/1764 (84%)	1446 (98%)	29 (2%)	63	73

5 of 29 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	996	LYS
1	B	154	ILE
1	B	671	ARG
1	A	1012	THR
1	B	359	PHE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	810	ASN
1	B	711	ASN
1	B	44	GLN
1	A	711	ASN
1	B	564	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$
1	CRO	A	853	1	22,22,24	4.57	6 (27%)	29,30,34	3.37	6 (20%)
1	CRO	B	853	1	22,22,24	4.56	6 (27%)	29,30,34	3.58	8 (27%)

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
1	CRO	A	853	1	-	0/8/29/32	0/2/2/2
1	CRO	B	853	1	-	2/8/29/32	0/2/2/2

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	853	CRO	CA2-C2	-10.67	1.37	1.48
1	B	853	CRO	CA2-C2	-9.68	1.38	1.48
1	A	853	CRO	OG1-CB1	-4.73	1.21	1.42
1	B	853	CRO	OG1-CB1	-4.56	1.22	1.42
1	A	853	CRO	C2-N3	-2.31	1.34	1.39

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	853	CRO	CG2-CB2-CA2	-11.30	115.97	130.27
1	A	853	CRO	O2-C2-CA2	-10.38	125.00	130.97
1	A	853	CRO	CG2-CB2-CA2	-9.32	118.47	130.27
1	B	853	CRO	O2-C2-CA2	-7.72	126.53	130.97
1	B	853	CRO	N3-C1-N2	-4.83	107.95	111.53

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	B	853	CRO	CG2-CB2-CA2-N2
1	B	853	CRO	CG2-CB2-CA2-C2

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	B	853	CRO	1	0

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

5 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	2OW	A	1101	-	31,31,31	2.84	12 (38%)	42,42,42	2.64	16 (38%)
2	2OW	B	1101	-	31,31,31	2.89	15 (48%)	42,42,42	2.76	18 (42%)
3	GOL	B	1102	-	5,5,5	0.24	0	5,5,5	0.58	0
3	GOL	B	1103	-	5,5,5	0.42	0	5,5,5	0.75	0
3	GOL	B	1104	-	5,5,5	0.17	0	5,5,5	0.41	0

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	2OW	A	1101	-	-	0/18/28/28	1/3/3/3
2	2OW	B	1101	-	-	0/18/28/28	0/3/3/3
3	GOL	B	1102	-	-	0/4/4/4	0/0/0/0
3	GOL	B	1103	-	-	0/4/4/4	0/0/0/0
3	GOL	B	1104	-	-	0/4/4/4	0/0/0/0

The worst 5 of 27 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1101	2OW	O02-C01	-4.42	1.34	1.45
2	A	1101	2OW	O02-C01	-4.22	1.35	1.45
2	B	1101	2OW	C29-N05	-4.17	1.39	1.47
2	A	1101	2OW	C29-N05	-3.56	1.40	1.47
2	B	1101	2OW	C09-C10	2.21	1.55	1.51

The worst 5 of 34 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	1101	2OW	C19-C20-N21	-5.00	120.64	124.54
2	B	1101	2OW	O04-C03-N05	-4.94	116.63	124.39
2	A	1101	2OW	C06-N05-C03	-4.73	108.39	121.73
2	A	1101	2OW	C10-C09-N08	-4.52	104.92	112.76
2	A	1101	2OW	C19-C20-N21	-4.33	121.17	124.54

There are no chirality outliers.

There are no torsion outliers.

All (1) ring outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1101	2OW	C06-C07-C28-C29-N05-N08

4 monomers are involved in 25 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1101	2OW	10	0
2	B	1101	2OW	12	0
3	B	1103	GOL	2	0
3	B	1104	GOL	1	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	974/1024 (95%)	0.26	51 (5%) 31 34	15, 40, 79, 100	0
1	B	920/1024 (89%)	0.76	159 (17%) 2 2	17, 35, 104, 130	0
All	All	1894/2048 (92%)	0.50	210 (11%) 7 7	15, 38, 99, 130	0

The worst 5 of 210 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	803	VAL	12.0
1	B	875	MET	8.9
1	B	725	LEU	8.3
1	B	871	PHE	8.1
1	B	874	ALA	7.5

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
1	CRO	B	853	21/23	0.63	0.37	-	92,98,105,109	0
1	CRO	A	853	21/23	0.94	0.14	-	49,56,73,81	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(Å ²)	Q<0.9
2	2OW	A	1101	29/29	0.82	0.33	10.75	25,48,59,65	0
2	2OW	B	1101	29/29	0.74	0.44	7.52	26,70,78,79	0
3	GOL	B	1103	6/6	0.92	0.17	3.88	28,34,39,41	0
3	GOL	B	1104	6/6	0.84	0.21	2.72	36,41,43,47	0
3	GOL	B	1102	6/6	0.88	0.13	-0.25	39,42,44,50	0

6.5 Other polymers [i](#)

There are no such residues in this entry.