



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 12:34 AM GMT

PDB ID : 2AWM
Title : GFP R96A chromophore maturation recovery mutant R96A Q183R
Authors : Wood, T.I.; Barondeau, D.P.; Hitomi, C.; Kassmann, C.J.; Tainer, J.A.; Getzoff, E.D.
Deposited on : 2005-09-01
Resolution : 1.70 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
<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 (RC4), CSD as536be (2015)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026688
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) : trunk26865

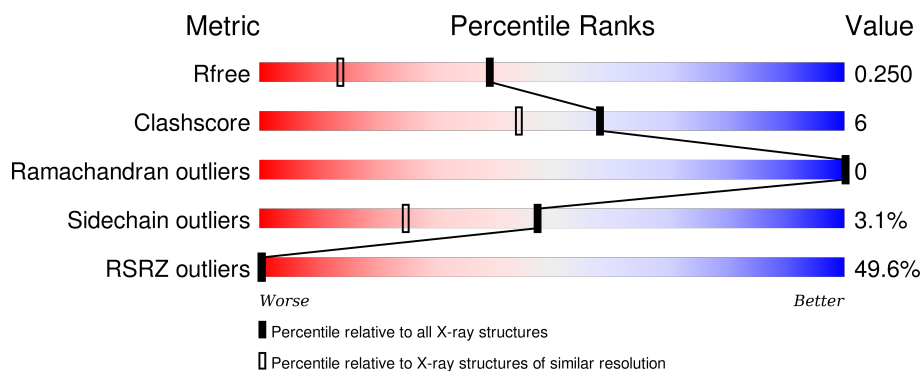
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION


The reported resolution of this entry is 1.70 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))
R_{free}	91344	3190 (1.70-1.70)
Clashscore	102246	3585 (1.70-1.70)
Ramachandran outliers	100387	3527 (1.70-1.70)
Sidechain outliers	100360	3527 (1.70-1.70)
RSRZ outliers	91569	3200 (1.70-1.70)

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 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	228	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2102 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 green fluorescent protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	225	Total	C	N	O	S	0	0	0
			1792	1137	303	347	5			

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1A	ALA	-	EXPRESSION TAG	UNP P42212
A	64	LEU	PHE	ENGINEERED	UNP P42212
A	66	CRO	SER	CHROMOPHORE	UNP P42212
A	66	CRO	TYR	CHROMOPHORE	UNP P42212
A	66	CRO	GLY	CHROMOPHORE	UNP P42212
A	96	ALA	ARG	ENGINEERED	UNP P42212
A	99	SER	PHE	ENGINEERED	UNP P42212
A	153	THR	MET	ENGINEERED	UNP P42212
A	163	ALA	VAL	ENGINEERED	UNP P42212
A	183	ARG	GLN	ENGINEERED	UNP P42212

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Mg	0	0
			2	2		

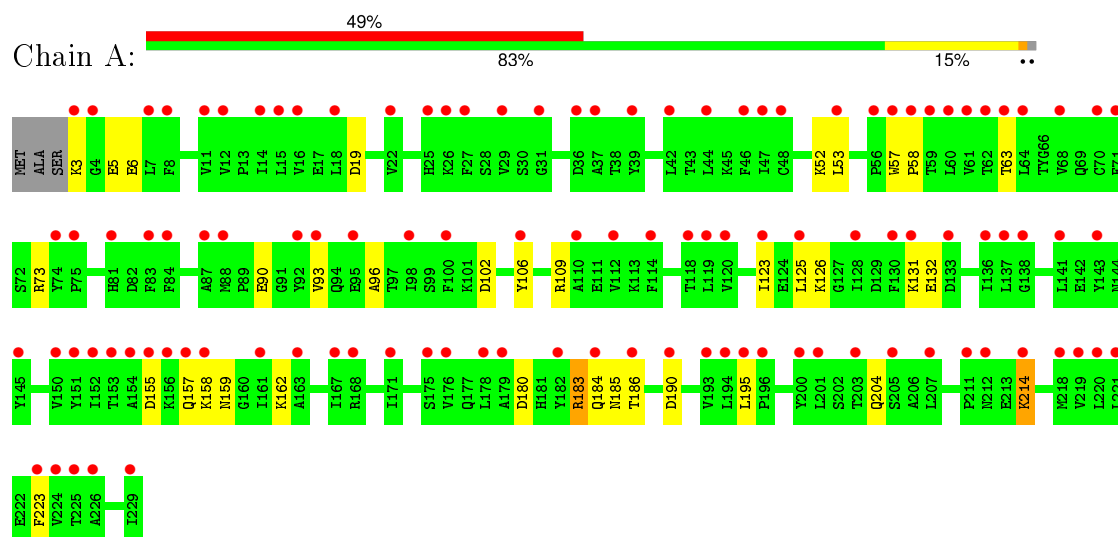
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	308	Total	O	0	0
			308	308		

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 ($RSRZ > 2$). 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: green fluorescent protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	51.51Å 62.34Å 71.26Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 1.70 30.93 – 1.70	Depositor EDS
% Data completeness (in resolution range)	91.1 (50.00-1.70) 91.1 (30.93-1.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.06	Depositor
$\langle I/\sigma(I) \rangle$ ¹	7.43 (at 1.70Å)	Xtriage
Refinement program	SHELXL-97	Depositor
R, R_{free}	0.164 , 0.223 0.228 , 0.250	Depositor DCC
R_{free} test set	1145 reflections (5.09%)	DCC
Wilson B-factor (Å ²)	1.1	Xtriage
Anisotropy	2.541	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 71.0	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.29$, $\langle L^2 \rangle = 0.13$	Xtriage
Outliers	0 of 23644 reflections	Xtriage
F_o, F_c correlation	0.89	EDS
Total number of atoms	2102	wwPDB-VP
Average B, all atoms (Å ²)	17.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.37% 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: MG, CRO

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	0.41	0/1809	1.03	4/2444 (0.2%)

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	183	ARG	NE-CZ-NH2	-8.35	116.12	120.30
1	A	109	ARG	NE-CZ-NH1	-6.39	117.10	120.30
1	A	106	TYR	CB-CG-CD1	6.29	124.78	121.00
1	A	73	ARG	NE-CZ-NH1	-5.12	117.74	120.30

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	1792	0	1739	21	0
2	A	2	0	0	0	0
3	A	308	0	0	6	3
All	All	2102	0	1739	21	3

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 6.

All (21) 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:102:ASP:O	1:A:131:LYS:NZ	1.95	0.97
1:A:180:ASP:OD1	3:A:1277:HOH:O	1.95	0.85
1:A:132:GLU:O	3:A:1232:HOH:O	1.97	0.81
1:A:19:ASP:OD2	3:A:1037:HOH:O	2.05	0.74
1:A:162:LYS:HD2	3:A:1223:HOH:O	2.06	0.54
1:A:183:ARG:C	1:A:184:GLN:HG3	2.29	0.53
1:A:195:LEU:HD22	1:A:195:LEU:N	2.24	0.53
1:A:186:THR:HG23	3:A:1086:HOH:O	2.14	0.48
1:A:204:GLN:HG2	1:A:223:PHE:HB2	1.96	0.48
1:A:90:GLU:H	1:A:90:GLU:CD	2.16	0.47
1:A:3:LYS:HB3	1:A:6:GLU:HG3	1.96	0.46
1:A:3:LYS:HA	1:A:3:LYS:HD2	1.81	0.45
1:A:53:LEU:HD22	1:A:57:TRP:CE2	2.52	0.44
1:A:214:LYS:HB2	3:A:1057:HOH:O	2.19	0.43
1:A:57:TRP:N	1:A:58:PRO:CD	2.82	0.42
1:A:96:ALA:HB2	1:A:183:ARG:HD2	1.99	0.42
1:A:93:VAL:O	1:A:185:ASN:HA	2.20	0.42
1:A:63:THR:CG2	1:A:123:ILE:HG21	2.50	0.42
1:A:155:ASP:OD1	1:A:155:ASP:C	2.58	0.42
1:A:158:LYS:O	1:A:159:ASN:HB3	2.19	0.42
1:A:125:LEU:C	1:A:125:LEU:HD23	2.41	0.41

All (3) 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)
3:A:1263:HOH:O	3:A:1309:HOH:O[4_555]	1.78	0.42
3:A:1197:HOH:O	3:A:1296:HOH:O[3_645]	1.87	0.33
3:A:1040:HOH:O	3:A:1286:HOH:O[2_665]	2.13	0.07

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	220/228 (96%)	218 (99%)	2 (1%)	0	100	100

There are no Ramachandran outliers to report.

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	194/196 (99%)	188 (97%)	6 (3%)	47	25

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	5	GLU
1	A	52	LYS
1	A	126	LYS
1	A	157	GLN
1	A	190	ASP
1	A	214	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	164	ASN
1	A	204	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

1 non-standard protein/DNA/RNA residue is 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	66	1	23,23,24	2.04	6 (26%)	29,32,34	1.79	9 (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
1	CRO	A	66	1	-	0/12/31/32	0/2/2/2

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	66	CRO	CA2-C2	-6.69	1.41	1.48
1	A	66	CRO	CA3-N3	-2.72	1.42	1.47
1	A	66	CRO	CG2-CB2	-2.37	1.42	1.46
1	A	66	CRO	CA1-C1	2.26	1.54	1.51
1	A	66	CRO	CD1-CE1	2.48	1.43	1.38
1	A	66	CRO	CB2-CA2	3.68	1.38	1.35

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	66	CRO	CB2-CA2-N2	-2.95	123.40	128.67
1	A	66	CRO	CG1-CB1-CA1	-2.69	108.56	112.53
1	A	66	CRO	O2-C2-CA2	-2.59	129.54	130.95
1	A	66	CRO	CD1-CE1-CZ	-2.46	117.03	119.87
1	A	66	CRO	C2-CA2-N2	2.04	110.54	108.91
1	A	66	CRO	CA1-C1-N2	2.04	126.64	123.83
1	A	66	CRO	CB2-CA2-C2	2.53	126.06	122.36
1	A	66	CRO	CG2-CB2-CA2	3.59	134.88	130.22

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	66	CRO	C3-CA3-N3	4.82	123.56	113.00

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 2 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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 ⓘ

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	224/228 (98%)	2.02	111 (49%) 0 0	6, 12, 30, 88	0

All (111) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	178	LEU	4.2
1	A	200	TYR	4.2
1	A	98	ILE	4.0
1	A	182	TYR	3.8
1	A	157	GLN	3.8
1	A	152	ILE	3.7
1	A	119	LEU	3.7
1	A	83	PHE	3.5
1	A	150	VAL	3.4
1	A	100	PHE	3.4
1	A	219	VAL	3.3
1	A	151	TYR	3.3
1	A	61	VAL	3.3
1	A	229	ILE	3.3
1	A	11	VAL	3.2
1	A	92	TYR	3.2
1	A	47	ILE	3.2
1	A	158	LYS	3.2
1	A	179	ALA	3.1
1	A	226	ALA	3.1
1	A	112	VAL	3.1
1	A	57	TRP	3.1
1	A	220	LEU	3.1
1	A	163	ALA	3.0
1	A	120	VAL	3.0
1	A	114	PHE	3.0
1	A	22	VAL	3.0

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Mol	Chain	Res	Type	RSRZ
1	A	84	PHE	3.0
1	A	171	ILE	2.9
1	A	133	ASP	2.9
1	A	156	LYS	2.9
1	A	71	PHE	2.9
1	A	190	ASP	2.9
1	A	153	THR	2.9
1	A	167	ILE	2.9
1	A	53	LEU	2.8
1	A	195	LEU	2.8
1	A	211	PRO	2.8
1	A	176	VAL	2.8
1	A	161	ILE	2.8
1	A	60	LEU	2.8
1	A	168	ARG	2.8
1	A	12	VAL	2.8
1	A	68	VAL	2.8
1	A	154	ALA	2.7
1	A	137	LEU	2.7
1	A	123	ILE	2.7
1	A	194	LEU	2.7
1	A	141	LEU	2.6
1	A	70	CYS	2.6
1	A	184	GLN	2.6
1	A	224	VAL	2.6
1	A	223	PHE	2.6
1	A	93	VAL	2.5
1	A	125	LEU	2.5
1	A	75	PRO	2.5
1	A	4	GLY	2.5
1	A	15	LEU	2.5
1	A	128	ILE	2.5
1	A	214	LYS	2.5
1	A	44	LEU	2.4
1	A	62	THR	2.4
1	A	29	VAL	2.4
1	A	136	ILE	2.4
1	A	74	TYR	2.4
1	A	143	TYR	2.4
1	A	193	VAL	2.4
1	A	110	ALA	2.4
1	A	42	LEU	2.4

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Mol	Chain	Res	Type	RSRZ
1	A	221	LEU	2.4
1	A	8	PHE	2.4
1	A	39	TYR	2.4
1	A	46	PHE	2.4
1	A	7	LEU	2.3
1	A	207	LEU	2.3
1	A	131	LYS	2.3
1	A	64	LEU	2.3
1	A	27	PHE	2.3
1	A	63	THR	2.3
1	A	14	ILE	2.3
1	A	37	ALA	2.2
1	A	201	LEU	2.2
1	A	175	SER	2.2
1	A	145	TYR	2.2
1	A	56	PRO	2.2
1	A	186	THR	2.2
1	A	203	THR	2.2
1	A	196	PRO	2.2
1	A	16	VAL	2.2
1	A	118	THR	2.2
1	A	225	THR	2.2
1	A	218	MET	2.2
1	A	48	CYS	2.2
1	A	31	GLY	2.2
1	A	26	LYS	2.2
1	A	25	HIS	2.2
1	A	205	SER	2.1
1	A	18	LEU	2.1
1	A	87	ALA	2.1
1	A	212	ASN	2.1
1	A	59	THR	2.1
1	A	130	PHE	2.1
1	A	58	PRO	2.1
1	A	88	MET	2.1
1	A	3	LYS	2.1
1	A	95	GLU	2.1
1	A	138	GLY	2.0
1	A	81	HIS	2.0
1	A	155	ASP	2.0
1	A	106	TYR	2.0
1	A	36	ASP	2.0

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	A	66	22/23	0.91	0.18	-	4,9,15,16	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	MG	A	302	1/1	0.85	0.26	-	42,42,42,42	0
2	MG	A	300	1/1	0.93	0.16	-	23,23,23,23	0

6.5 Other polymers [i](#)

There are no such residues in this entry.