



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 06:03 AM GMT

PDB ID : 2VRA
Title : DROSOPHILA ROBO IG1-2 (MONOCLINIC FORM)
Authors : Fukuhara, N.; Howitt, J.A.; Hussain, S.; Hohenester, E.
Deposited on : 2008-03-28
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
<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

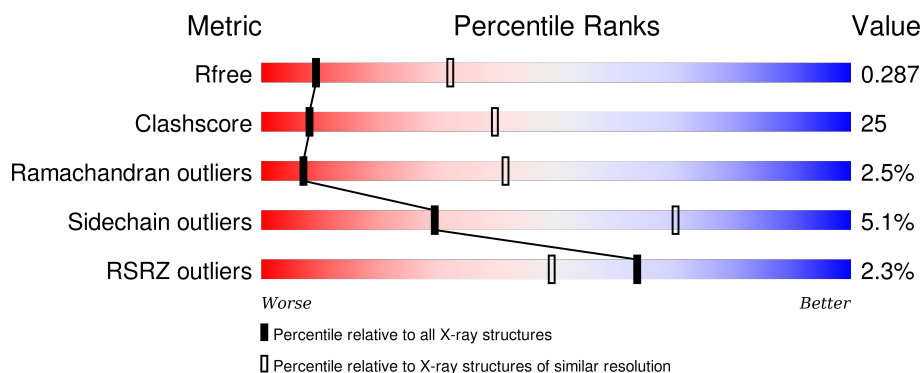
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 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))
R_{free}	91344	1124 (3.24-3.16)
Clashscore	102246	1024 (3.22-3.18)
Ramachandran outliers	100387	1004 (3.22-3.18)
Sidechain outliers	100360	1003 (3.22-3.18)
RSRZ outliers	91569	1129 (3.24-3.16)

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	208	<div> <div></div> <div>52%43%..</div> </div>
1	B	208	<div> <div>2%</div> <div></div> <div>55%40%..</div> </div>
1	C	208	<div> <div>2%</div> <div></div> <div>50%41%.8%</div> </div>
1	D	208	<div> <div>4%</div> <div></div> <div>48%41%.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	SO4	A	1253	-	-	-	X
2	SO4	A	1254	-	-	-	X
2	SO4	D	1251	-	-	-	X
3	IDS	B	1256	-	-	-	X

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5939 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 ROUNDABOUT 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	203	Total	C	N	O	S	0	0	1
			1526	959	264	297	6			
1	B	202	Total	C	N	O	S	0	0	1
			1508	949	256	297	6			
1	C	192	Total	C	N	O	S	0	0	1
			1411	889	243	274	5			
1	D	188	Total	C	N	O	S	0	0	1
			1369	866	230	268	5			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	47	ALA	-	EXPRESSION TAG	UNP O44924
A	48	PRO	-	EXPRESSION TAG	UNP O44924
A	49	LEU	-	EXPRESSION TAG	UNP O44924
B	47	ALA	-	EXPRESSION TAG	UNP O44924
B	48	PRO	-	EXPRESSION TAG	UNP O44924
B	49	LEU	-	EXPRESSION TAG	UNP O44924
C	47	ALA	-	EXPRESSION TAG	UNP O44924
C	48	PRO	-	EXPRESSION TAG	UNP O44924
C	49	LEU	-	EXPRESSION TAG	UNP O44924
D	47	ALA	-	EXPRESSION TAG	UNP O44924
D	48	PRO	-	EXPRESSION TAG	UNP O44924
D	49	LEU	-	EXPRESSION TAG	UNP O44924

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O₄S).

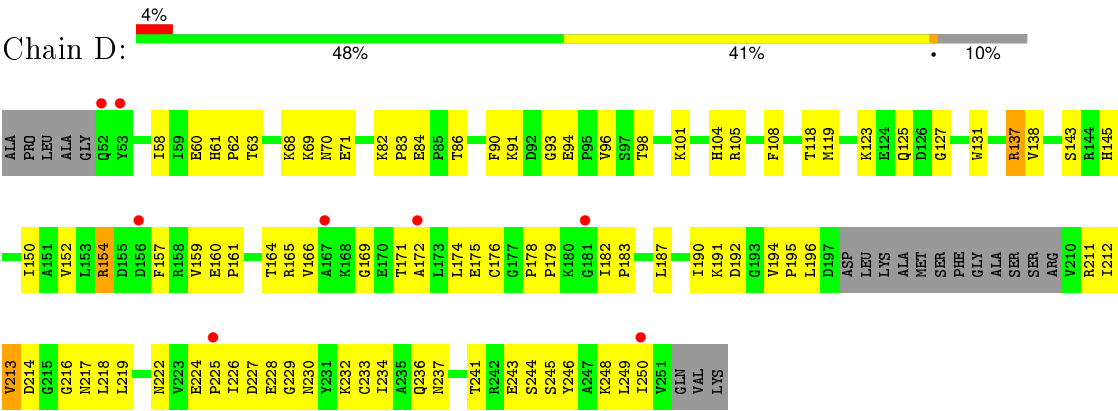


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	O	S			
			5	4	1		0	0
2	A	1	Total	O	S			
			5	4	1		0	0
2	A	1	Total	O	S			
			5	4	1		0	0
2	B	1	Total	O	S			
			5	4	1		0	0
2	B	1	Total	O	S			
			5	4	1		0	0
2	C	1	Total	O	S			
			5	4	1		0	0
2	C	1	Total	O	S			
			5	4	1		0	0
2	C	1	Total	O	S			
			5	4	1		0	0
2	D	1	Total	O	S			
			5	4	1		0	0
2	D	1	Total	O	S			
			5	4	1		0	0
2	D	1	Total	O	S			
			5	4	1		0	0

- Molecule 3 is a polymer of unknown type called SUGAR (4-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
3	B	4	Total	C	N	O	S		
			70	24	2	38	6	0	0

● Molecule 1: ROUNABOUT 1



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	64.94Å 84.43Å 107.13Å 90.00° 98.55° 90.00°	Depositor
Resolution (Å)	20.00 – 3.20 19.87 – 3.20	Depositor EDS
% Data completeness (in resolution range)	99.5 (20.00-3.20) 100.0 (19.87-3.20)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.78 (at 3.22Å)	Xtriage
Refinement program	CNS 1.2	Depositor
R, R_{free}	0.251 , 0.286 0.251 , 0.287	Depositor DCC
R_{free} test set	1872 reflections (10.91%)	DCC
Wilson B-factor (Å ²)	76.1	Xtriage
Anisotropy	0.450	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 38.8	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	1 of 19023 reflections (0.005%)	Xtriage
F_o, F_c correlation	0.89	EDS
Total number of atoms	5939	wwPDB-VP
Average B, all atoms (Å ²)	69.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.12% 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: SO4, IDS, SGN

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	0.46	0/1558	0.68	0/2123
1	B	0.52	0/1540	0.64	0/2101
1	C	0.44	0/1441	0.66	0/1969
1	D	0.45	0/1399	0.63	0/1916
All	All	0.47	0/5938	0.66	0/8109

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	1526	0	1446	78	0
1	B	1508	0	1415	68	0
1	C	1411	0	1297	66	0
1	D	1369	0	1252	76	0
2	A	15	0	0	0	0
2	B	10	0	0	0	0
2	C	15	0	0	1	0
2	D	15	0	0	0	0
3	B	70	0	27	1	0
All	All	5939	0	5437	279	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 25.

The worst 5 of 279 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:C:224:GLU:HB3	1:C:225:PRO:HD2	1.40	1.02
1:B:85:PRO:HB3	1:B:136:ASN:HB3	1.45	0.95
1:B:152:VAL:HG22	1:B:182:ILE:HG22	1.56	0.87
1:C:210:VAL:HG22	1:C:220:ILE:HA	1.56	0.86
1:D:152:VAL:HG22	1:D:182:ILE:HG22	1.55	0.85

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	201/208 (97%)	174 (87%)	20 (10%)	7 (4%)	4	31
1	B	200/208 (96%)	172 (86%)	25 (12%)	3 (2%)	13	55
1	C	188/208 (90%)	159 (85%)	24 (13%)	5 (3%)	6	39
1	D	184/208 (88%)	157 (85%)	23 (12%)	4 (2%)	8	45
All	All	773/832 (93%)	662 (86%)	92 (12%)	19 (2%)	7	41

5 of 19 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	123	LYS
1	C	126	ASP
1	A	53	TYR
1	A	168	LYS
1	A	209	ARG

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	159/177 (90%)	151 (95%)	8 (5%)	30	71
1	B	157/177 (89%)	148 (94%)	9 (6%)	25	67
1	C	141/177 (80%)	134 (95%)	7 (5%)	30	71
1	D	137/177 (77%)	131 (96%)	6 (4%)	35	74
All	All	594/708 (84%)	564 (95%)	30 (5%)	29	70

5 of 30 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	194	VAL
1	B	221	SER
1	D	137	ARG
1	B	208	SER
1	C	63	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	236	GLN
1	C	70	ASN
1	C	236	GLN
1	B	70	ASN
1	C	149	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

4 carbohydrates 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
3	SGN	B	1253	3	18,20,20	1.16	1 (5%)	20,31,31	1.62	2 (10%)
3	IDS	B	1254	3	13,16,17	1.45	2 (15%)	17,24,26	2.65	5 (29%)
3	SGN	B	1255	3	17,19,20	1.12	1 (5%)	19,29,31	1.56	3 (15%)
3	IDS	B	1256	3	12,15,17	1.68	4 (33%)	12,22,26	0.96	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
3	SGN	B	1253	3	-	0/11/31/31	0/1/1/1
3	IDS	B	1254	3	-	0/5/26/29	0/1/1/1
3	SGN	B	1255	3	-	0/11/28/31	0/1/1/1
3	IDS	B	1256	3	-	0/5/22/29	1/1/1/1

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	1256	IDS	O2-C2	-2.97	1.42	1.47
3	B	1254	IDS	O2-C2	-2.37	1.43	1.47
3	B	1256	IDS	C4-C3	2.05	1.56	1.52
3	B	1255	SGN	C1-C2	2.36	1.55	1.52
3	B	1256	IDS	C4-C5	2.38	1.56	1.52

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	1254	IDS	O4-C4-C3	-5.34	98.31	110.34
3	B	1253	SGN	O4-C4-C3	-5.23	98.55	110.34

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	B	1255	SGN	O4-C4-C5	-4.74	96.69	109.24
3	B	1255	SGN	O2S-S1-N	-2.10	105.69	108.50
3	B	1254	IDS	C4-C3-C2	2.09	113.84	110.20

There are no chirality outliers.

There are no torsion outliers.

All (1) ring outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	1256	IDS	C1-C2-C3-C4-C5-O5

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	1254	IDS	1	0

5.6 Ligand geometry

11 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	SO4	A	1253	-	4,4,4	0.30	0	6,6,6	0.11	0
2	SO4	A	1254	-	4,4,4	0.27	0	6,6,6	0.21	0
2	SO4	A	1255	-	4,4,4	0.41	0	6,6,6	0.25	0
2	SO4	B	1257	-	4,4,4	0.21	0	6,6,6	0.10	0
2	SO4	B	1258	-	4,4,4	2.00	1 (25%)	6,6,6	0.73	0
2	SO4	C	1253	-	4,4,4	0.37	0	6,6,6	0.20	0
2	SO4	C	1254	-	4,4,4	0.45	0	6,6,6	0.12	0
2	SO4	C	1255	-	4,4,4	0.49	0	6,6,6	0.11	0
2	SO4	D	1251	-	4,4,4	0.27	0	6,6,6	0.15	0
2	SO4	D	1252	-	4,4,4	0.43	0	6,6,6	0.24	0
2	SO4	D	1253	-	4,4,4	0.43	0	6,6,6	0.21	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	SO4	A	1253	-	-	0/0/0/0	0/0/0/0
2	SO4	A	1254	-	-	0/0/0/0	0/0/0/0
2	SO4	A	1255	-	-	0/0/0/0	0/0/0/0
2	SO4	B	1257	-	-	0/0/0/0	0/0/0/0
2	SO4	B	1258	-	-	0/0/0/0	0/0/0/0
2	SO4	C	1253	-	-	0/0/0/0	0/0/0/0
2	SO4	C	1254	-	-	0/0/0/0	0/0/0/0
2	SO4	C	1255	-	-	0/0/0/0	0/0/0/0
2	SO4	D	1251	-	-	0/0/0/0	0/0/0/0
2	SO4	D	1252	-	-	0/0/0/0	0/0/0/0
2	SO4	D	1253	-	-	0/0/0/0	0/0/0/0

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1258	SO4	O2-S	2.47	1.55	1.47

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	1253	SO4	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	203/208 (97%)	-0.26	1 (0%) 91 87	41, 62, 90, 99	0
1	B	202/208 (97%)	-0.17	5 (2%) 61 47	39, 64, 88, 111	0
1	C	192/208 (92%)	-0.12	4 (2%) 67 52	46, 69, 105, 109	0
1	D	188/208 (90%)	0.00	8 (4%) 39 25	42, 68, 101, 106	0
All	All	785/832 (94%)	-0.14	18 (2%) 64 49	39, 66, 99, 111	0

The worst 5 of 18 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	253	VAL	6.8
1	B	54	GLN	5.1
1	D	181	GLY	3.0
1	C	250	ILE	2.8
1	B	121	GLY	2.8

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [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
3	IDS	B	1256	15/17	0.81	0.36	2.65	126,130,131,131	0
3	SGN	B	1255	19/20	0.89	0.14	-1.63	121,127,127,128	0
3	SGN	B	1253	20/20	0.81	0.28	-	133,134,135,135	0
3	IDS	B	1254	16/17	0.78	0.23	-	128,132,133,133	0

6.4 Ligands

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
2	SO4	A	1253	5/5	0.81	0.30	3.19	125,125,126,126	0
2	SO4	A	1254	5/5	0.82	0.33	3.12	121,122,123,123	0
2	SO4	D	1251	5/5	0.86	0.33	3.08	151,151,152,152	0
2	SO4	D	1252	5/5	0.85	0.26	1.68	125,126,127,127	0
2	SO4	B	1258	5/5	0.89	0.27	1.64	88,88,90,90	0
2	SO4	D	1253	5/5	0.93	0.22	0.81	126,126,127,127	0
2	SO4	C	1253	5/5	0.89	0.22	0.36	116,117,117,117	0
2	SO4	A	1255	5/5	0.94	0.18	-0.25	100,100,101,101	0
2	SO4	C	1254	5/5	0.89	0.31	-	136,136,136,137	0
2	SO4	B	1257	5/5	0.91	0.17	-	119,119,119,120	0
2	SO4	C	1255	5/5	0.83	0.30	-	135,135,135,136	0

6.5 Other polymers

There are no such residues in this entry.