wwPDB X-ray Structure Validation Summary Report (i)

May 17, 2020 – 05:59 am BST

PDB ID	:	5GTF
Title	:	Crystal structure of onion lachrymatory factor synthase (LFS) containing glycerol
Authors	:	Takabe, J.; Arakawa, T.; Masamura, N.; Tsuge, N.; Imai, S.; Fushinobu, S.
Deposited on	:	2016-08-20
Resolution	:	1.80 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
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

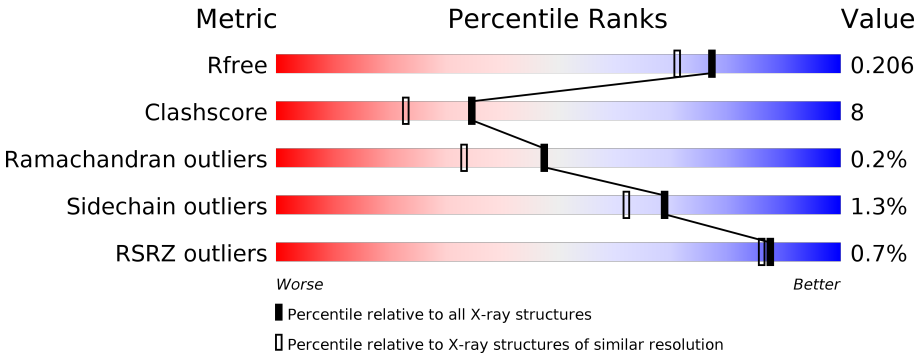
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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}	130704	5950 (1.80-1.80)
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)
RSRZ outliers	127900	5850 (1.80-1.80)

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 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 <=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	175	74% 9% • 15%
1	B	175	73% 11% • 15%
1	C	175	2% 74% 12% • 13%
1	D	175	% 78% 9% • 13%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5626 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 Lachrymatory-factor synthase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	149	Total	C	N	O	S	0	1	0
			1211	780	192	229	10			
1	B	149	Total	C	N	O	S	0	0	0
			1205	776	192	227	10			
1	C	153	Total	C	N	O	S	0	1	0
			1233	792	199	232	10			
1	D	153	Total	C	N	O	S	0	3	0
			1244	800	199	234	11			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	170	HIS	-	expression tag	UNP P59082
A	171	HIS	-	expression tag	UNP P59082
A	172	HIS	-	expression tag	UNP P59082
A	173	HIS	-	expression tag	UNP P59082
A	174	HIS	-	expression tag	UNP P59082
A	175	HIS	-	expression tag	UNP P59082
B	170	HIS	-	expression tag	UNP P59082
B	171	HIS	-	expression tag	UNP P59082
B	172	HIS	-	expression tag	UNP P59082
B	173	HIS	-	expression tag	UNP P59082
B	174	HIS	-	expression tag	UNP P59082
B	175	HIS	-	expression tag	UNP P59082
C	170	HIS	-	expression tag	UNP P59082
C	171	HIS	-	expression tag	UNP P59082
C	172	HIS	-	expression tag	UNP P59082
C	173	HIS	-	expression tag	UNP P59082
C	174	HIS	-	expression tag	UNP P59082
C	175	HIS	-	expression tag	UNP P59082
D	170	HIS	-	expression tag	UNP P59082
D	171	HIS	-	expression tag	UNP P59082
D	172	HIS	-	expression tag	UNP P59082

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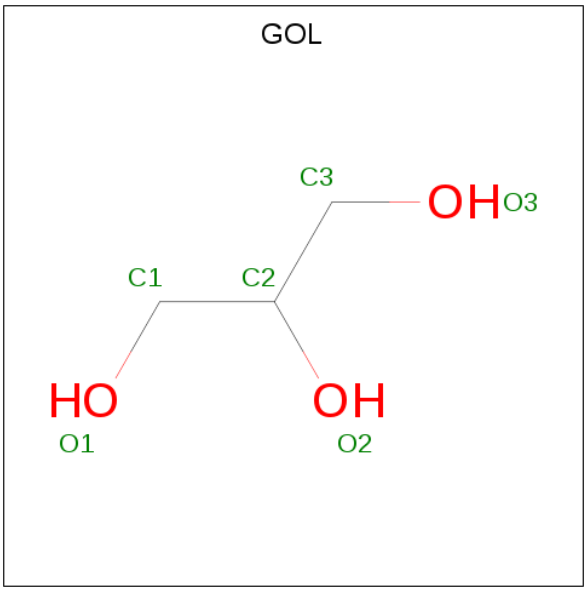
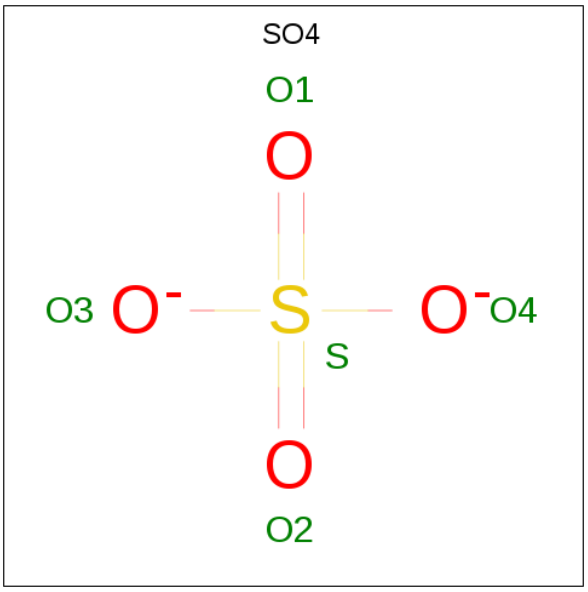
Chain	Residue	Modelled	Actual	Comment	Reference
D	173	HIS	-	expression tag	UNP P59082
D	174	HIS	-	expression tag	UNP P59082
D	175	HIS	-	expression tag	UNP P59082

- Molecule 2 is GLYCEROL (three-letter code: GOL) (formula: $C_3H_8O_3$).



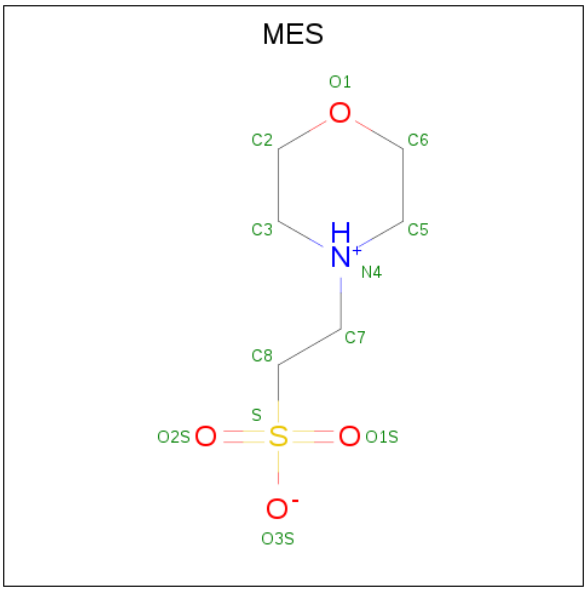
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 6 3 3	0	0
2	A	1	Total C O 6 3 3	0	0
2	B	1	Total C O 6 3 3	0	0
2	B	1	Total C O 6 3 3	0	0
2	B	1	Total C O 6 3 3	0	0
2	C	1	Total C O 6 3 3	0	0
2	C	1	Total C O 6 3 3	0	0
2	D	1	Total C O 6 3 3	0	0

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



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

- Molecule 4 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES) (formula: $C_6H_{13}NO_4S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	D	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 5 is water.

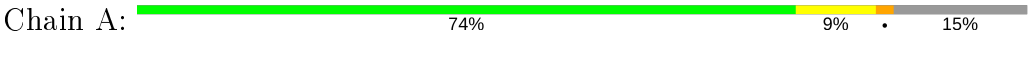
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	176	Total	O	0	0
			176	176		
5	B	177	Total	O	0	0
			177	177		
5	C	155	Total	O	0	0
			155	155		
5	D	140	Total	O	0	0
			140	140		

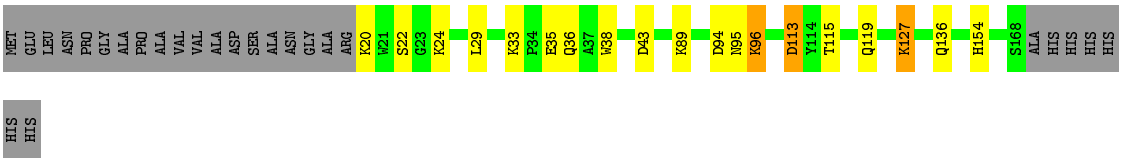
3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes 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: Lachrymatory-factor synthase

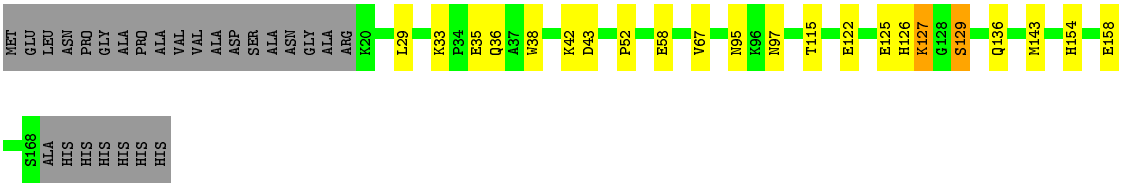
Chain A:





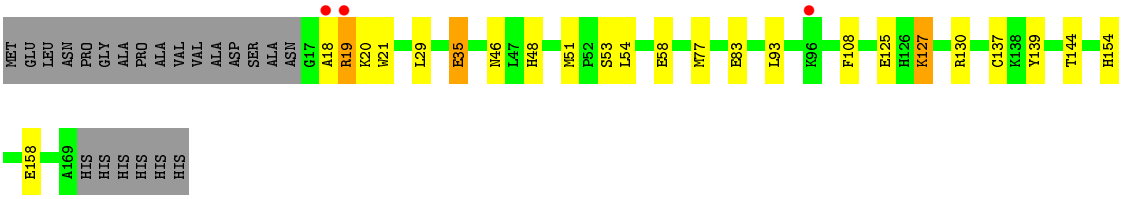
- Molecule 1: Lachrymatory-factor synthase

Chain B:



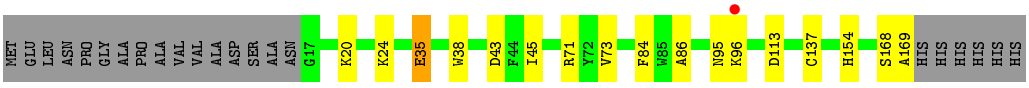
- Molecule 1: Lachrymatory-factor synthase

Chain C:



- Molecule 1: Lachrymatory-factor synthase

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	65.00Å 119.94Å 125.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 1.80 45.16 – 1.80	Depositor EDS
% Data completeness (in resolution range)	99.6 (50.00-1.80) 99.6 (45.16-1.80)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.72 (at 1.79Å)	Xtriage
Refinement program	REFMAC 5.8.0073	Depositor
R, R_{free}	0.170 , 0.199 0.181 , 0.206	Depositor DCC
R_{free} test set	4585 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å^2)	18.7	Xtriage
Anisotropy	0.082	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 51.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.042 for -h,l,k	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	5626	wwPDB-VP
Average B, all atoms (Å^2)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.46% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, SO4, MES

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	1.04	0/1246	0.93	2/1686 (0.1%)
1	B	1.09	2/1237 (0.2%)	0.95	2/1674 (0.1%)
1	C	0.98	1/1268 (0.1%)	0.92	1/1715 (0.1%)
1	D	0.98	1/1285 (0.1%)	0.92	3/1737 (0.2%)
All	All	1.02	4/5036 (0.1%)	0.93	8/6812 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	D	0	1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	35	GLU	CG-CD	6.42	1.61	1.51
1	C	35	GLU	CG-CD	6.17	1.61	1.51
1	B	129	SER	CB-OG	-6.08	1.34	1.42
1	D	35	GLU	CG-CD	5.38	1.60	1.51

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

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	43	ASP	CB-CG-OD1	6.97	124.57	118.30
1	D	71	ARG	NE-CZ-NH2	-6.53	117.03	120.30
1	B	143	MET	CG-SD-CE	-6.25	90.20	100.20
1	A	113	ASP	CB-CG-OD2	-5.65	113.22	118.30
1	C	130	ARG	NE-CZ-NH1	5.52	123.06	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	D	168	SER	Peptide

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	1211	0	1171	21	0
1	B	1205	0	1165	19	0
1	C	1233	0	1196	24	0
1	D	1244	0	1211	17	0
2	A	12	0	16	0	0
2	B	18	0	24	2	0
2	C	12	0	16	3	0
2	D	6	0	8	0	0
3	A	5	0	0	0	0
3	B	10	0	0	0	0
3	C	10	0	0	0	0
4	D	12	0	13	1	0
5	A	176	0	0	10	0
5	B	177	0	0	11	0
5	C	155	0	0	16	0
5	D	140	0	0	16	0
All	All	5626	0	4820	81	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 8.

The worst 5 of 81 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:D:45:ILE:HD13	5:D:349:HOH:O	1.41	1.21
1:C:51:MET:HG2	5:C:303:HOH:O	1.51	1.10
1:B:136:GLN:HB3	5:B:303:HOH:O	1.58	1.01
1:B:115:THR:HB	5:B:303:HOH:O	1.60	1.00

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:137:CYS:SG	5:C:310:HOH:O	2.24	0.96

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	148/175 (85%)	147 (99%)	1 (1%)	0	100 100
1	B	147/175 (84%)	145 (99%)	2 (1%)	0	100 100
1	C	152/175 (87%)	151 (99%)	0	1 (1%)	22 10
1	D	154/175 (88%)	154 (100%)	0	0	100 100
All	All	601/700 (86%)	597 (99%)	3 (0%)	1 (0%)	47 33

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	19	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	133/150 (89%)	131 (98%)	2 (2%)	65 56

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
1	B	132/150 (88%)	131 (99%)	1 (1%)	81 78
1	C	134/150 (89%)	132 (98%)	2 (2%)	65 56
1	D	136/150 (91%)	134 (98%)	2 (2%)	65 56
All	All	535/600 (89%)	528 (99%)	7 (1%)	69 62

5 of 7 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	127	LYS
1	D	96	LYS
1	C	158	GLU
1	A	127	LYS
1	D	20	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 7 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	46	ASN
1	D	97	ASN
1	C	97	ASN
1	B	95	ASN
1	D	95	ASN

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 carbohydrates in this entry.

5.6 Ligand geometry (i)

14 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	$\#\|Z\| > 2$
3	SO4	B	204	-	4,4,4	0.29	0	6,6,6	0.32	0
2	GOL	B	202	-	5,5,5	0.92	0	5,5,5	1.73	1 (20%)
2	GOL	D	201	-	5,5,5	0.80	0	5,5,5	0.91	0
3	SO4	A	203	-	4,4,4	0.53	0	6,6,6	0.38	0
2	GOL	B	201	-	5,5,5	0.53	0	5,5,5	0.53	0
3	SO4	C	204	-	4,4,4	0.28	0	6,6,6	1.09	0
2	GOL	A	201	-	5,5,5	0.63	0	5,5,5	0.94	0
2	GOL	A	202	-	5,5,5	0.20	0	5,5,5	1.38	0
2	GOL	C	202	-	5,5,5	0.58	0	5,5,5	0.67	0
3	SO4	C	201	-	4,4,4	0.48	0	6,6,6	0.25	0
3	SO4	B	205	-	4,4,4	0.36	0	6,6,6	0.40	0
2	GOL	B	203	-	5,5,5	0.89	0	5,5,5	0.85	0
4	MES	D	202	-	12,12,12	1.86	1 (8%)	14,16,16	2.04	7 (50%)
2	GOL	C	203	-	5,5,5	0.80	0	5,5,5	1.87	2 (40%)

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	GOL	B	202	-	-	4/4/4/4	-
2	GOL	D	201	-	-	0/4/4/4	-
2	GOL	B	201	-	-	0/4/4/4	-
2	GOL	A	201	-	-	0/4/4/4	-
2	GOL	A	202	-	-	2/4/4/4	-
2	GOL	C	202	-	-	0/4/4/4	-
4	MES	D	202	-	-	3/6/14/14	0/1/1/1
2	GOL	B	203	-	-	1/4/4/4	-
2	GOL	C	203	-	-	0/4/4/4	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	D	202	MES	C8-S	-5.72	1.69	1.77

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

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	D	202	MES	C6-C5-N4	3.97	116.12	110.10
4	D	202	MES	O3S-S-C8	3.19	110.92	105.77
2	C	203	GOL	C3-C2-C1	-3.16	99.40	111.70
2	B	202	GOL	O3-C3-C2	-3.09	95.36	110.20
2	C	203	GOL	O2-C2-C3	2.59	120.53	109.12

There are no chirality outliers.

5 of 10 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	202	GOL	O1-C1-C2-C3
4	D	202	MES	C8-C7-N4-C5
2	B	202	GOL	O1-C1-C2-O2
2	A	202	GOL	O2-C2-C3-O3
2	B	202	GOL	C1-C2-C3-O3

There are no ring outliers.

3 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	202	GOL	2	0
4	D	202	MES	1	0
2	C	203	GOL	3	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

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, 95^{th} 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	149/175 (85%)	-0.33	0	100	100	11, 17, 31, 47	0
1	B	149/175 (85%)	-0.37	0	100	100	11, 17, 32, 42	0
1	C	153/175 (87%)	-0.38	3 (1%)	65	61	14, 19, 37, 52	0
1	D	153/175 (87%)	-0.42	1 (0%)	87	86	14, 19, 36, 49	0
All	All	604/700 (86%)	-0.38	4 (0%)	87	86	11, 18, 35, 52	0

All (4) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	18	ALA	2.9
1	D	96	LYS	2.5
1	C	96	LYS	2.3
1	C	19	ARG	2.0

6.2 Non-standard residues in protein, DNA, RNA chains

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

6.3 Carbohydrates

There are no carbohydrates in this entry.

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. The B-factors column lists the minimum, median, 95^{th} 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	B-factors(Å^2)	Q<0.9
4	MES	D	202	12/12	0.80	0.17	38,49,82,94	0
2	GOL	B	202	6/6	0.84	0.17	31,35,41,49	0
2	GOL	C	203	6/6	0.89	0.15	31,39,44,48	0
3	SO4	A	203	5/5	0.90	0.26	69,73,80,81	0
2	GOL	B	203	6/6	0.91	0.14	25,33,36,39	0
2	GOL	A	202	6/6	0.92	0.21	20,42,50,65	0
2	GOL	D	201	6/6	0.93	0.11	22,24,28,31	0
2	GOL	C	202	6/6	0.94	0.11	25,27,29,32	0
2	GOL	A	201	6/6	0.95	0.09	18,20,22,22	0
2	GOL	B	201	6/6	0.96	0.08	18,21,21,22	0
3	SO4	C	204	5/5	0.97	0.09	45,46,48,53	0
3	SO4	B	204	5/5	0.98	0.09	39,43,46,49	0
3	SO4	C	201	5/5	0.98	0.12	43,44,46,49	0
3	SO4	B	205	5/5	0.98	0.07	34,35,38,39	0

6.5 Other polymers (i)

There are no such residues in this entry.