



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 22, 2017 – 01:46 AM EDT

PDB ID : 5XNX
Title : Crystallographic structure of the enzymatically active N-terminal domain of the Rel protein from Mycobacterium tuberculosis
Authors : Singal, B.; Balakrishna, A.M.; Manimekalai, M.S.S.; Nartey, W.; Gruber, G.
Deposited on : unknown
Resolution : 3.70 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
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20029824
Percentile statistics	:	20161228.v01 (using entries in the PDB archive December 28th 2016)
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-20029824

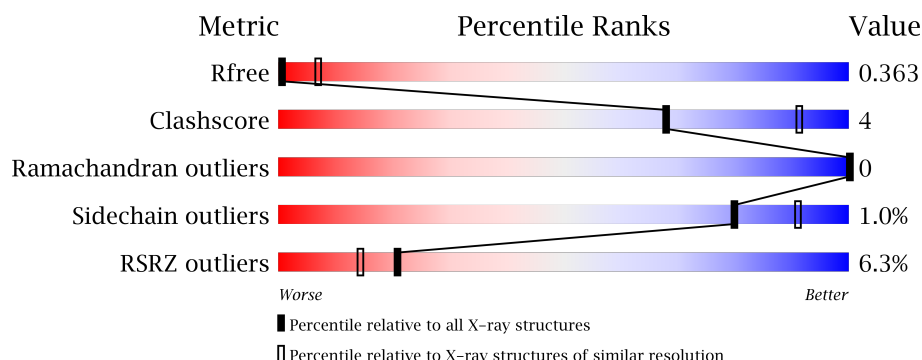
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.70 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}	100719	1234 (3.90-3.50)
Clashscore	112137	1377 (3.90-3.50)
Ramachandran outliers	110173	1323 (3.90-3.50)
Sidechain outliers	110143	1320 (3.90-3.50)
RSRZ outliers	101464	1262 (3.90-3.50)

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	394	<div> <div>4%</div> <div>70% 11% 18%</div> </div>
1	B	394	<div> <div>6%</div> <div>76% • 20%</div> </div>
1	C	394	<div> <div>6%</div> <div>75% 5% 20%</div> </div>
1	D	394	<div> <div>6%</div> <div>78% • 19%</div> </div>

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 9449 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.

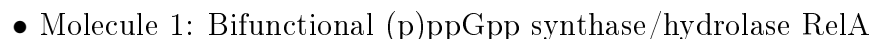
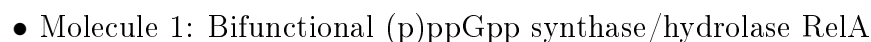
- Molecule 1 is a protein called Bifunctional (p)ppGpp synthase/hydrolase RelA.

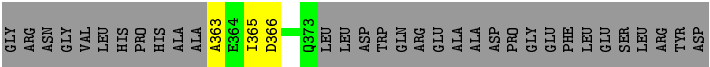
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	323	Total	C	N	O	S	0	0	0
			2413	1531	429	444	9			
1	B	316	Total	C	N	O	S	0	0	0
			2303	1448	413	433	9			
1	C	316	Total	C	N	O	S	0	0	0
			2316	1452	416	438	10			
1	D	321	Total	C	N	O	S	0	0	0
			2414	1528	429	449	8			

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

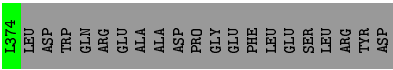
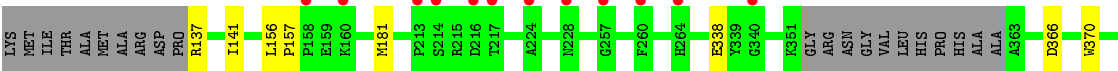
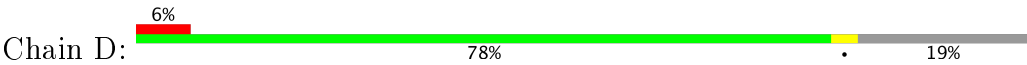
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Mg	0	0
			1	1		
2	D	1	Total	Mg	0	0
			1	1		
2	C	1	Total	Mg	0	0
			1	1		

- Molecule 1: Bifunctional (p)ppGpp synthase/hydrolase RelA





● Molecule 1: Bifunctional (p)ppGpp synthase/hydrolase RelA



4 Data and refinement statistics

Property	Value	Source
Space group	P 32	Depositor
Cell constants a, b, c, α , β , γ	161.71 Å 161.71 Å 75.56 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	10.02 – 3.70 10.02 – 3.70	Depositor EDS
% Data completeness (in resolution range)	94.2 (10.02-3.70) 99.5 (10.02-3.70)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.01 (at 3.73 Å)	Xtriage
Refinement program	REFMAC 5.8.0135	Depositor
R, R_{free}	0.350 , 0.368 0.347 , 0.363	Depositor DCC
R_{free} test set	1122 reflections (5.29%)	DCC
Wilson B-factor (Å ²)	100.6	Xtriage
Anisotropy	0.233	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 33.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.149 for -h,-k,l 0.159 for h,-h-k,-l 0.154 for -k,-h,-l	Xtriage
Reported twinning fraction	0.247 for H, K, L 0.252 for -K, -H, -L 0.249 for K, H, -L 0.252 for -h,-k,l	Depositor
Outliers	0 of 22319 reflections	Xtriage
F_o, F_c correlation	0.78	EDS
Total number of atoms	9449	wwPDB-VP
Average B, all atoms (Å ²)	107.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.01% of the height of the origin peak. No significant pseudotranslation is detected.*

¹ Intensities estimated from amplitudes.

² Theoretical 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: MG

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	0.38	0/2461	0.62	0/3354
1	B	0.37	0/2339	0.61	0/3185
1	C	0.37	0/2353	0.60	0/3202
1	D	0.38	0/2457	0.62	0/3342
All	All	0.38	0/9610	0.62	0/13083

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	2413	0	2277	44	0
1	B	2303	0	2154	15	0
1	C	2316	0	2172	18	0
1	D	2414	0	2303	5	0
2	A	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
All	All	9449	0	8906	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 4.

All (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:A:264:HIS:CD2	1:A:322:LYS:CB	2.39	1.04
1:A:370:TRP:O	1:A:374:LEU:HD23	1.59	1.03
1:B:181:MET:HA	1:B:338:GLU:O	1.72	0.90
1:A:370:TRP:O	1:A:374:LEU:CD2	2.21	0.89
1:A:264:HIS:CG	1:A:322:LYS:CB	2.64	0.81
1:C:79:LEU:HD11	1:C:82:THR:HG21	1.65	0.77
1:B:181:MET:CB	1:B:339:TYR:O	2.33	0.76
1:D:137:ARG:O	1:D:141:ILE:HG12	1.88	0.72
1:A:264:HIS:NE2	1:A:322:LYS:CB	2.52	0.71
1:A:193:PHE:CD1	1:A:247:TRP:CE3	2.80	0.68
1:B:179:LEU:HD23	1:B:343:ALA:HB3	1.75	0.67
1:A:193:PHE:CD1	1:A:247:TRP:HE3	2.13	0.65
1:C:79:LEU:CD1	1:C:82:THR:HG21	2.29	0.62
1:C:79:LEU:HG	1:C:79:LEU:O	2.00	0.60
1:A:99:GLU:OE1	1:A:99:GLU:N	2.28	0.60
1:A:318:GLY:N	1:A:319:PRO:CD	2.64	0.60
1:A:157:PRO:HB3	1:B:198:PRO:HB2	1.84	0.60
1:A:290:TRP:NE1	1:A:319:PRO:HB3	2.17	0.60
1:A:370:TRP:C	1:A:374:LEU:HD23	2.21	0.59
1:A:156:LEU:N	1:A:157:PRO:HD2	2.18	0.59
1:A:264:HIS:CE1	1:A:322:LYS:CB	2.85	0.59
1:A:289:LEU:HB2	1:A:290:TRP:CE3	2.38	0.58
1:B:181:MET:N	1:B:340:GLY:HA3	2.18	0.58
1:D:82:THR:O	1:D:86:THR:HG22	2.03	0.58
1:B:179:LEU:CD2	1:B:343:ALA:HB3	2.34	0.57
1:A:374:LEU:O	1:A:378:GLN:NE2	2.38	0.57
1:A:290:TRP:CD1	1:A:319:PRO:HB3	2.40	0.57
1:C:67:LEU:CD2	1:C:339:TYR:HD1	2.18	0.56
1:A:330:THR:O	1:A:334:HIS:N	2.33	0.55
1:B:72:THR:OG1	1:B:137:ARG:NH1	2.39	0.55
1:A:317:VAL:HG12	1:A:318:GLY:N	2.22	0.55
1:C:156:LEU:N	1:C:157:PRO:HD2	2.22	0.55
1:A:338:GLU:OE2	1:A:338:GLU:HA	2.06	0.54
1:C:56:HIS:NE2	1:C:145:ASP:OD1	2.38	0.54
1:A:80:HIS:HA	1:A:105:VAL:HG13	1.90	0.53
1:A:341:ILE:HD12	1:A:341:ILE:N	2.23	0.53
1:C:67:LEU:HD23	1:C:339:TYR:CD1	2.44	0.53
1:A:273:CYS:O	1:A:330:THR:HA	2.08	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:179:LEU:HA	1:C:343:ALA:HB2	1.91	0.52
1:B:181:MET:CA	1:B:338:GLU:O	2.52	0.52
1:C:363:ALA:O	1:C:366:ASP:HB3	2.09	0.52
1:C:67:LEU:HD23	1:C:339:TYR:HD1	1.76	0.51
1:A:94:THR:O	1:A:98:GLY:N	2.40	0.51
1:A:318:GLY:N	1:A:319:PRO:HD2	2.26	0.50
1:B:271:ILE:C	1:B:272:LEU:HD12	2.32	0.50
1:A:160:LYS:O	1:A:161:GLN:C	2.49	0.50
1:A:370:TRP:O	1:A:374:LEU:HD22	2.09	0.50
1:A:370:TRP:HA	1:A:373:GLN:OE1	2.11	0.50
1:B:181:MET:H	1:B:340:GLY:HA3	1.76	0.49
1:A:193:PHE:CD1	1:A:247:TRP:CZ3	3.00	0.49
1:A:229:THR:HG21	1:A:289:LEU:HD21	1.95	0.49
1:B:182:ALA:O	1:B:185:LYS:N	2.45	0.49
1:B:179:LEU:HA	1:B:343:ALA:HB2	1.95	0.48
1:A:346:ARG:O	1:A:347:TYR:HB3	2.13	0.48
1:A:112:ASP:O	1:A:377:TRP:CZ2	2.67	0.47
1:C:365:ILE:HD12	1:C:365:ILE:N	2.30	0.47
1:C:77:ALA:HA	1:C:80:HIS:CD2	2.50	0.47
1:A:147:LEU:HD13	1:A:188:LEU:HG	1.97	0.47
1:B:179:LEU:HD23	1:B:343:ALA:CB	2.45	0.46
1:A:157:PRO:N	1:A:158:PRO:HD2	2.29	0.46
1:A:347:TYR:O	1:A:347:TYR:CD2	2.69	0.46
1:B:182:ALA:O	1:B:183:SER:C	2.55	0.45
1:C:336:THR:CG2	1:C:337:ALA:N	2.80	0.45
1:B:181:MET:HA	1:B:338:GLU:C	2.34	0.44
1:A:317:VAL:CG1	1:A:318:GLY:N	2.81	0.44
1:A:193:PHE:CG	1:A:247:TRP:HE3	2.35	0.44
1:C:335:ARG:O	1:C:339:TYR:O	2.36	0.44
1:C:79:LEU:CD1	1:C:82:THR:CG2	2.96	0.44
1:A:179:LEU:O	1:A:342:ALA:C	2.56	0.43
1:C:365:ILE:HD12	1:C:365:ILE:H	1.84	0.43
1:D:181:MET:HA	1:D:338:GLU:O	2.19	0.42
1:D:156:LEU:N	1:D:157:PRO:CD	2.83	0.42
1:A:366:ASP:O	1:A:370:TRP:HD1	2.02	0.42
1:C:79:LEU:HD12	1:C:82:THR:HB	2.01	0.42
1:A:369:ALA:O	1:A:373:GLN:HB3	2.20	0.41
1:A:373:GLN:OE1	1:A:374:LEU:HD22	2.21	0.41
1:A:75:VAL:O	1:A:78:LEU:HB2	2.20	0.41
1:A:104:LEU:HA	1:A:138:VAL:HG22	2.03	0.40
1:D:366:ASP:OD1	1:D:370:TRP:NE1	2.54	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:82:THR:O	1:A:86:THR:N	2.50	0.40
1:C:363:ALA:O	1:C:366:ASP:N	2.54	0.40

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	315/394 (80%)	296 (94%)	19 (6%)	0	100	100
1	B	306/394 (78%)	289 (94%)	17 (6%)	0	100	100
1	C	308/394 (78%)	287 (93%)	21 (7%)	0	100	100
1	D	311/394 (79%)	295 (95%)	16 (5%)	0	100	100
All	All	1240/1576 (79%)	1167 (94%)	73 (6%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2 Protein sidechains [i](#)

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	228/329 (69%)	226 (99%)	2 (1%)	82	92
1	B	214/329 (65%)	212 (99%)	2 (1%)	82	92
1	C	218/329 (66%)	215 (99%)	3 (1%)	71	89

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	232/329 (70%)	230 (99%)	2 (1%)	82	92
All	All	892/1316 (68%)	883 (99%)	9 (1%)	80	91

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	23	TYR
1	A	373	GLN
1	B	236	LYS
1	B	371	MET
1	C	103	HIS
1	C	167	GLU
1	C	336	THR
1	D	23	TYR
1	D	70	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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](#)

Of 3 ligands modelled in this entry, 3 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	323/394 (81%)	0.30	15 (4%) 33 24	61, 102, 139, 148	0
1	B	316/394 (80%)	0.34	22 (6%) 17 12	59, 106, 138, 156	0
1	C	316/394 (80%)	0.47	22 (6%) 17 12	69, 108, 157, 169	0
1	D	321/394 (81%)	0.45	22 (6%) 18 13	66, 103, 137, 148	0
All	All	1276/1576 (80%)	0.39	81 (6%) 21 14	59, 104, 143, 169	0

All (81) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	259	ASP	5.5
1	C	27	ASP	4.9
1	B	228	ASN	4.7
1	A	159	GLU	4.6
1	A	26	ALA	4.4
1	D	213	PRO	4.3
1	D	214	SER	4.3
1	C	26	ALA	4.2
1	B	85	ASP	4.0
1	D	257	GLY	3.8
1	B	26	ALA	3.7
1	C	259	ASP	3.7
1	C	24	PRO	3.7
1	C	13	GLU	3.7
1	D	217	THR	3.6
1	D	84	GLU	3.6
1	A	257	GLY	3.5
1	D	85	ASP	3.5
1	C	33	ARG	3.5
1	B	95	GLU	3.4
1	D	228	ASN	3.4

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Mol	Chain	Res	Type	RSRZ
1	B	40	GLN	3.4
1	D	40	GLN	3.4
1	C	85	ASP	3.3
1	A	32	GLN	3.3
1	C	28	LEU	3.2
1	C	87	GLY	3.2
1	B	231	THR	3.1
1	C	32	GLN	3.1
1	C	40	GLN	3.0
1	D	26	ALA	3.0
1	C	257	GLY	3.0
1	C	68	GLY	3.0
1	C	95	GLU	2.9
1	A	217	THR	2.9
1	C	21	GLU	2.9
1	D	340	GLY	2.8
1	A	27	ASP	2.8
1	A	259	ASP	2.8
1	B	257	GLY	2.8
1	A	33	ARG	2.8
1	A	216	ASP	2.7
1	C	98	GLY	2.7
1	D	24	PRO	2.7
1	D	27	ASP	2.7
1	B	33	ARG	2.6
1	B	229	THR	2.6
1	C	36	GLU	2.6
1	D	224	ALA	2.6
1	A	28	LEU	2.6
1	C	214	SER	2.5
1	C	39	ASP	2.5
1	A	229	THR	2.5
1	B	213	PRO	2.5
1	D	158	PRO	2.4
1	C	96	GLU	2.4
1	D	33	ARG	2.4
1	C	86	THR	2.4
1	D	216	ASP	2.4
1	B	99	GLU	2.4
1	A	36	GLU	2.4
1	D	13	GLU	2.4
1	B	27	ASP	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	261	ASP	2.4
1	D	23	TYR	2.3
1	D	260	PHE	2.3
1	B	21	GLU	2.3
1	B	24	PRO	2.3
1	B	303	GLN	2.3
1	A	198	PRO	2.3
1	D	264	HIS	2.2
1	D	25	LYS	2.2
1	D	160	LYS	2.2
1	B	336	THR	2.1
1	A	24	PRO	2.1
1	B	294	ALA	2.1
1	A	228	ASN	2.0
1	B	224	ALA	2.0
1	B	258	ARG	2.0
1	B	96	GLU	2.0
1	C	228	ASN	2.0

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](#)

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	401	1/1	0.82	0.13	-	53,53,53,53	0
2	MG	D	401	1/1	0.95	0.07	-	73,73,73,73	0
2	MG	C	401	1/1	0.75	0.17	-	75,75,75,75	0

6.5 Other polymers [i](#)

There are no such residues in this entry.