



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 07:04 AM GMT

PDB ID : 2ZE9
Title : Crystal structure of H168A mutant of phospholipase D from Streptomyces antibioticus, as a complex with phosphatidylcholine
Authors : Suzuki, A.; Toda, H.; Iwasaki, Y.; Yamane, T.; Yamane, T.
Deposited on : 2007-12-06
Resolution : 2.30 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

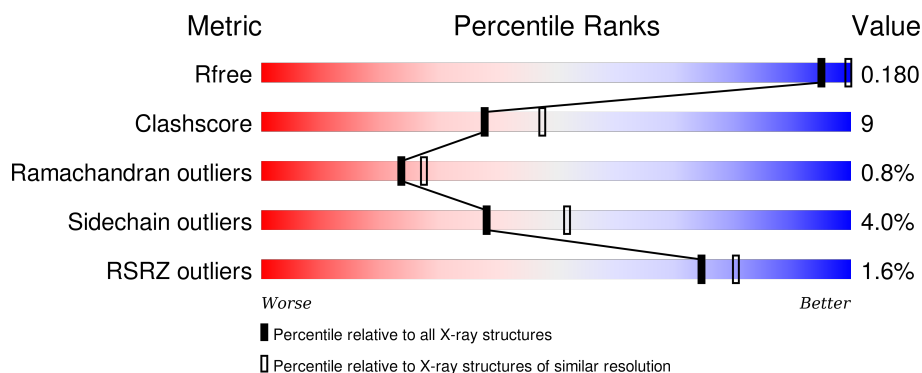
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

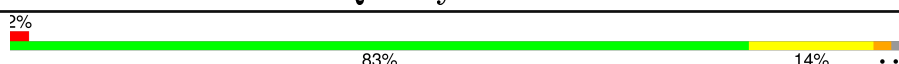
The reported resolution of this entry is 2.30 Å.

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	3852 (2.30-2.30)
Clashscore	102246	4452 (2.30-2.30)
Ramachandran outliers	100387	4410 (2.30-2.30)
Sidechain outliers	100360	4409 (2.30-2.30)
RSRZ outliers	91569	3857 (2.30-2.30)

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	509	

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 4161 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.

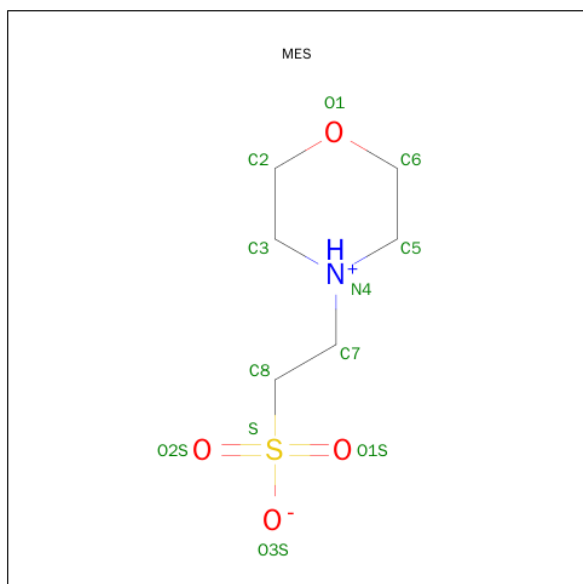
- Molecule 1 is a protein called Phospholipase D.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	504	3758	2333	666	746	13	0	0	0

There are 3 discrepancies between the modelled and reference sequences:

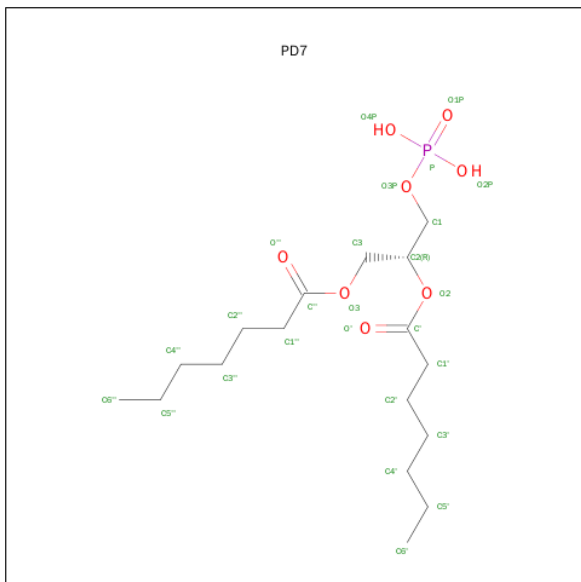
Chain	Residue	Modelled	Actual	Comment	Reference
A	107	SER	VAL	SEE REMARK 999	UNP Q53728
A	168	ALA	HIS	ENGINEERED	UNP Q53728
A	211	ARG	ALA	SEE REMARK 999	UNP Q53728

- Molecule 2 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (three-letter code: MES) (formula: C₆H₁₃NO₄S).



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

- Molecule 3 is (2R)-3-(PHOSPHONOXY)PROPANE-1,2-DIYL DIHEPTANOATE (three-letter code: PD7) (formula: $C_{17}H_{33}O_8P$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	P	0	0
			26	17	8	1		

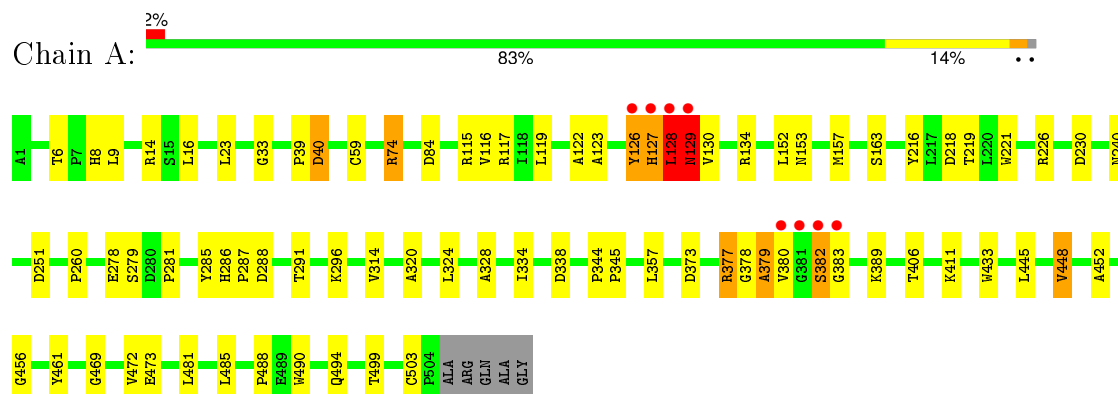
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	365	Total	O	0	0
			365	365		

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: Phospholipase D



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	60.87Å 78.23Å 98.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.04 – 2.30 48.04 – 2.30	Depositor EDS
% Data completeness (in resolution range)	95.8 (48.04-2.30) 96.3 (48.04-2.30)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.71 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.3.0040	Depositor
R, R_{free}	0.170 , 0.251 0.174 , 0.180	Depositor DCC
R_{free} test set	1070 reflections (5.44%)	DCC
Wilson B-factor (Å ²)	14.6	Xtriage
Anisotropy	0.379	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 28.7	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	1 of 20741 reflections (0.005%)	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	4161	wwPDB-VP
Average B, all atoms (Å ²)	13.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.26% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: PD7, 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	0.90	0/3842	0.92	7/5245 (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	A	0	1

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	A	129	ASN	N-CA-C	6.80	129.36	111.00
1	A	230	ASP	CB-CG-OD2	6.40	124.06	118.30
1	A	218	ASP	CB-CG-OD1	5.71	123.44	118.30
1	A	117	ARG	NE-CZ-NH1	5.71	123.15	120.30
1	A	129	ASN	CB-CA-C	-5.48	99.44	110.40
1	A	373	ASP	CB-CG-OD2	5.42	123.18	118.30
1	A	84	ASP	CB-CG-OD1	5.13	122.92	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	128	LEU	Peptide

5.2 Too-close contacts ⓘ

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	3758	0	3657	69	0
2	A	12	0	12	0	0
3	A	26	0	31	4	0
4	A	365	0	0	7	0
All	All	4161	0	3700	69	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 9.

All (69) 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:74:ARG:HB2	1:A:74:ARG:HH11	0.92	1.02
1:A:74:ARG:HB2	1:A:74:ARG:NH1	1.78	0.97
1:A:378:GLY:HA3	1:A:379:ALA:HB3	1.44	0.97
1:A:127:HIS:HA	1:A:128:LEU:HB2	1.47	0.93
1:A:74:ARG:CB	1:A:74:ARG:HH11	1.82	0.92
1:A:122:ALA:HB1	1:A:127:HIS:HD2	1.38	0.87
1:A:127:HIS:HB2	1:A:130:VAL:HG12	1.61	0.83
1:A:377:ARG:NH2	1:A:389:LYS:HE2	1.94	0.83
1:A:127:HIS:CB	1:A:130:VAL:HG12	2.10	0.82
1:A:126:TYR:H	1:A:126:TYR:HD2	1.24	0.81
1:A:382:SER:H	1:A:383:GLY:HA2	1.45	0.80
1:A:16:LEU:HD21	1:A:320:ALA:HB2	1.70	0.72
1:A:378:GLY:CA	1:A:379:ALA:HB3	2.22	0.69
1:A:122:ALA:HB1	1:A:127:HIS:CD2	2.26	0.69
1:A:285:TYR:CZ	1:A:287:PRO:HG3	2.29	0.68
1:A:127:HIS:CB	1:A:130:VAL:CG1	2.73	0.67
1:A:129:ASN:ND2	4:A:793:HOH:O	2.26	0.66
1:A:127:HIS:HB2	1:A:130:VAL:CG1	2.28	0.64
1:A:378:GLY:HA3	1:A:379:ALA:CB	2.23	0.63
1:A:382:SER:N	1:A:383:GLY:HA2	2.13	0.62
1:A:129:ASN:O	1:A:134:ARG:NH1	2.28	0.61
1:A:126:TYR:HE2	3:A:511:PD7:H6'A	1.66	0.60
1:A:285:TYR:CE2	1:A:287:PRO:HG3	2.36	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:378:GLY:CA	1:A:379:ALA:CB	2.80	0.59
1:A:128:LEU:HB3	1:A:130:VAL:HB	1.85	0.59
1:A:126:TYR:N	1:A:126:TYR:CD2	2.73	0.57
1:A:127:HIS:HA	1:A:128:LEU:CB	2.22	0.57
1:A:127:HIS:HB3	1:A:130:VAL:CG1	2.34	0.57
1:A:122:ALA:CB	1:A:127:HIS:HD2	2.16	0.54
1:A:123:ALA:O	1:A:127:HIS:CD2	2.61	0.53
1:A:128:LEU:HD23	1:A:130:VAL:HB	1.92	0.51
1:A:379:ALA:HB3	1:A:382:SER:OG	2.10	0.51
1:A:127:HIS:HB3	1:A:130:VAL:HG11	1.93	0.50
1:A:456:GLY:HA3	1:A:469:GLY:HA3	1.93	0.50
1:A:503:CYS:HB3	4:A:787:HOH:O	2.11	0.49
1:A:226:ARG:HD2	4:A:657:HOH:O	2.13	0.48
1:A:334:ILE:HD11	1:A:357:LEU:HD21	1.96	0.48
1:A:338:ASP:HB2	1:A:461:TYR:CD2	2.49	0.48
1:A:499:THR:HG22	1:A:503:CYS:HB2	1.95	0.47
1:A:377:ARG:CZ	1:A:389:LYS:HE2	2.44	0.47
1:A:33:GLY:HA3	1:A:260:PRO:HB3	1.95	0.47
1:A:406:THR:HB	1:A:411:LYS:HD2	1.97	0.47
1:A:126:TYR:CZ	3:A:511:PD7:H4'	2.51	0.46
1:A:6:THR:HB	1:A:9:LEU:HB2	1.97	0.46
1:A:129:ASN:H	1:A:129:ASN:HD22	1.64	0.46
1:A:240:ASN:HB2	4:A:799:HOH:O	2.16	0.46
1:A:328:ALA:HB2	1:A:448:VAL:HG22	1.98	0.45
1:A:59:CYS:HB2	1:A:433:TRP:CZ3	2.52	0.45
1:A:279:SER:O	1:A:281:PRO:HD3	2.16	0.45
1:A:126:TYR:CE2	3:A:511:PD7:H6'A	2.49	0.44
1:A:40:ASP:O	4:A:685:HOH:O	2.21	0.44
1:A:8:HIS:CD2	1:A:448:VAL:CG1	3.00	0.44
1:A:324:LEU:O	1:A:448:VAL:HG21	2.18	0.43
1:A:216:TYR:O	1:A:219:THR:HB	2.17	0.43
1:A:452:ALA:HA	1:A:472:VAL:O	2.18	0.43
1:A:445:LEU:HD11	1:A:481:LEU:HD21	2.00	0.43
1:A:119:LEU:HB2	1:A:221:TRP:CZ2	2.54	0.43
1:A:382:SER:H	1:A:383:GLY:CA	2.22	0.43
1:A:126:TYR:CE2	3:A:511:PD7:H4'	2.54	0.43
1:A:39:PRO:HD3	4:A:712:HOH:O	2.17	0.43
1:A:23:LEU:HD21	1:A:314:VAL:HA	2.01	0.43
1:A:9:LEU:HG	1:A:473:GLU:HB2	2.01	0.42
1:A:490:TRP:O	1:A:494:GLN:HG2	2.19	0.42
1:A:74:ARG:HD2	4:A:565:HOH:O	2.19	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:485:LEU:C	1:A:488:PRO:HD2	2.41	0.41
1:A:344:PRO:HB2	1:A:345:PRO:HA	2.02	0.41
1:A:115:ARG:HH12	1:A:251:ASP:HB2	1.86	0.41
1:A:116:VAL:HB	1:A:152:LEU:HD23	2.03	0.40
1:A:130:VAL:HG13	1:A:130:VAL:O	2.21	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	502/509 (99%)	480 (96%)	18 (4%)	4 (1%)	24 27

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	129	ASN
1	A	379	ALA
1	A	380	VAL
1	A	128	LEU

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	398/400 (100%)	382 (96%)	16 (4%)	38 52

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	14	ARG
1	A	40	ASP
1	A	74	ARG
1	A	126	TYR
1	A	127	HIS
1	A	153	ASN
1	A	157	MET
1	A	163	SER
1	A	278	GLU
1	A	286	HIS
1	A	288	ASP
1	A	291	THR
1	A	296	LYS
1	A	377	ARG
1	A	382	SER
1	A	448	VAL

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	29	GLN
1	A	127	HIS
1	A	129	ASN
1	A	340	ASN
1	A	387	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 ⓘ

There are no carbohydrates in this entry.

5.6 Ligand geometry ⓘ

2 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	MES	A	510	-	11,12,12	0.70	0	14,16,16	2.77	6 (42%)
3	PD7	A	511	-	25,25,25	1.23	2 (8%)	28,30,30	1.78	5 (17%)

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	MES	A	510	-	-	0/6/14/14	0/1/1/1
3	PD7	A	511	-	-	0/27/27/27	0/0/0/0

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	511	PD7	O2-C'	3.50	1.44	1.34
3	A	511	PD7	O3-C''	3.76	1.44	1.33

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	511	PD7	O3-C''-O''	-4.12	112.86	123.49
3	A	511	PD7	C2-O2-C'	-3.51	109.47	117.89
2	A	510	MES	C7-C8-S	-2.21	105.67	112.51
3	A	511	PD7	O2-C'-O'	-2.16	117.87	123.67
2	A	510	MES	O1-C2-C3	-2.15	106.91	111.84

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Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	A	510	MES	C6-C5-N4	2.70	114.22	110.12
2	A	510	MES	C7-N4-C5	3.53	120.31	111.27
3	A	511	PD7	O2-C'-C1'	3.97	120.17	111.53
2	A	510	MES	O2S-S-C8	4.19	110.48	106.91
3	A	511	PD7	O3-C''-C1''	4.90	126.82	111.90
2	A	510	MES	C5-N4-C3	7.10	124.28	108.90

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	511	PD7	4	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	504/509 (99%)	-0.51	8 (1%) 74 80	3, 11, 31, 46	0

All (8) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	128	LEU	7.2
1	A	380	VAL	7.0
1	A	126	TYR	6.3
1	A	381	GLY	4.5
1	A	382	SER	4.5
1	A	127	HIS	4.4
1	A	129	ASN	3.2
1	A	383	GLY	2.6

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(\AA^2)	Q<0.9
3	PD7	A	511	26/26	0.96	0.15	0.14	15,25,35,38	0
2	MES	A	510	12/12	0.96	0.11	-0.45	8,12,20,21	0

6.5 Other polymers [i](#)

There are no such residues in this entry.