



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 1, 2026 – 01:01 PM UTC

PDB ID : 2YGW / pdb_00002ygw
Title : Crystal structure of human MCD
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Chaikuad, A.; von Delft, F.; Gileadi, O.; Kavanagh, K.; Bountra, C.; Arrow-
smith, C.H.; Weigelt, J.; Edwards, A.; Oppermann, U.
Deposited on : 2011-04-21
Resolution : 2.80 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

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

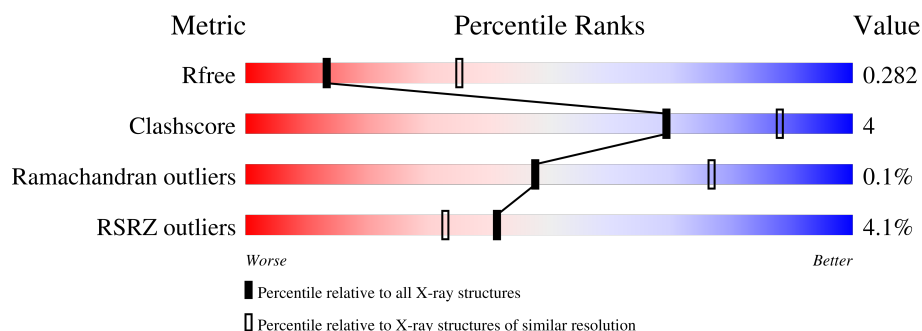
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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}	180053	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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 of 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 $\leq 5\%$. 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	460	
1	B	460	

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 6352 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 MALONYL-COA DECARBOXYLASE, MITOCHONDRIAL.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	416	Total	C	N	O	S	0	2	0
			3136	2013	553	555	15			
1	B	414	Total	C	N	O	S	0	3	0
			3128	2004	556	551	17			

There are 28 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-9	GLY	-	expression tag	UNP O95822
A	-8	THR	-	expression tag	UNP O95822
A	-7	GLU	-	expression tag	UNP O95822
A	-6	ASN	-	expression tag	UNP O95822
A	-5	LEU	-	expression tag	UNP O95822
A	-4	TYR	-	expression tag	UNP O95822
A	-3	PHE	-	expression tag	UNP O95822
A	-2	GLN	-	expression tag	UNP O95822
A	-1	SER	-	expression tag	UNP O95822
A	58	ALA	GLU	engineered mutation	UNP O95822
A	59	ALA	LYS	engineered mutation	UNP O95822
A	278	ALA	GLU	engineered mutation	UNP O95822
A	279	ALA	GLU	engineered mutation	UNP O95822
A	280	ALA	LYS	engineered mutation	UNP O95822
B	-9	GLY	-	expression tag	UNP O95822
B	-8	THR	-	expression tag	UNP O95822
B	-7	GLU	-	expression tag	UNP O95822
B	-6	ASN	-	expression tag	UNP O95822
B	-5	LEU	-	expression tag	UNP O95822
B	-4	TYR	-	expression tag	UNP O95822
B	-3	PHE	-	expression tag	UNP O95822
B	-2	GLN	-	expression tag	UNP O95822
B	-1	SER	-	expression tag	UNP O95822
B	58	ALA	GLU	engineered mutation	UNP O95822
B	59	ALA	LYS	engineered mutation	UNP O95822

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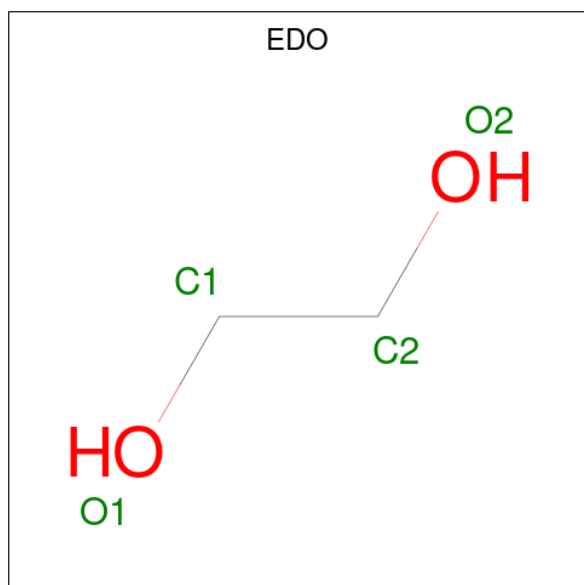
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Chain	Residue	Modelled	Actual	Comment	Reference
B	278	ALA	GLU	engineered mutation	UNP O95822
B	279	ALA	GLU	engineered mutation	UNP O95822
B	280	ALA	LYS	engineered mutation	UNP O95822

- Molecule 2 is UNKNOWN ATOM OR ION (CCD ID: UNX) (formula: X).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total X 1 1	0	0
2	B	1	Total X 1 1	0	0

- Molecule 3 is 1,2-ETHANEDIOL (CCD ID: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total C O 4 2 2	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	37	Total O 37 37	0	0
4	B	45	Total O 45 45	0	0

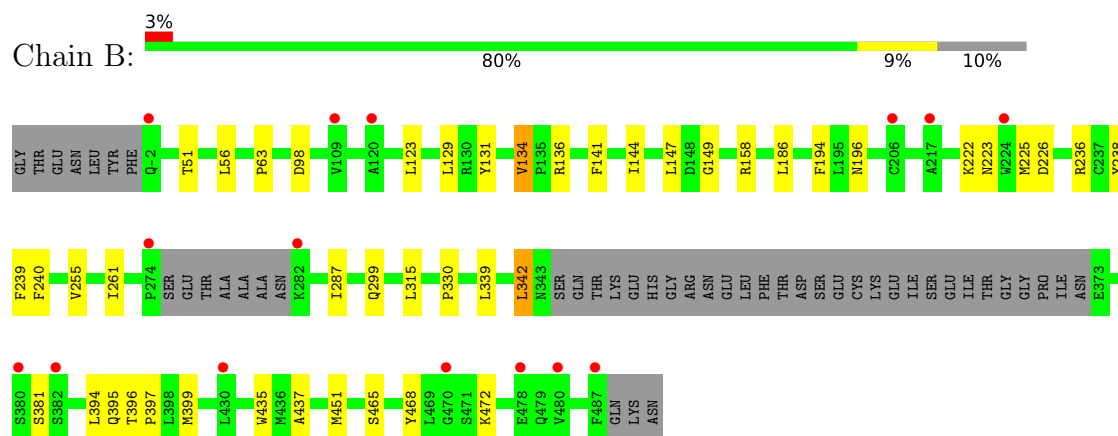
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide 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: MALONYL-COA DECARBOXYLASE, MITOCHONDRIAL



• Molecule 1: MALONYL-COA DECARBOXYLASE, MITOCHONDRIAL



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	95.63Å 175.34Å 151.76Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.73 – 2.80 29.73 – 2.80	Depositor EDS
% Data completeness (in resolution range)	(Not available) (29.73-2.80) 99.5 (29.73-2.80)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.53 (at 2.80Å)	Xtriage
Refinement program	BUSTER 2.8.0	Depositor
R, R_{free}	0.212 , 0.255 (Not available) , 0.282	Depositor DCC
R_{free} test set	1612 reflections (5.08%)	wwPDB-VP
Wilson B-factor (Å ²)	68.8	Xtriage
Anisotropy	0.137	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 63.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	0.029 for 1/2*h-1/2*k,-3/2*h-1/2*k,-l 0.043 for 1/2*h+1/2*k,3/2*h-1/2*k,-l	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	6352	wwPDB-VP
Average B, all atoms (Å ²)	73.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.50% 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, 0.333 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: EDO, UNX

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	0.88	1/3214 (0.0%)	1.44	14/4370 (0.3%)
1	B	0.89	1/3211 (0.0%)	1.41	15/4371 (0.3%)
All	All	0.89	2/6425 (0.0%)	1.43	29/8741 (0.3%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	134	VAL	CA-C	7.39	1.58	1.53
1	A	134	VAL	CA-C	5.62	1.57	1.53

All (29) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	196	ASN	CA-CB-CG	8.31	120.91	112.60
1	A	240	PHE	CA-CB-CG	7.77	121.57	113.80
1	B	240	PHE	CA-CB-CG	6.92	120.72	113.80
1	B	194	PHE	CA-CB-CG	6.66	120.45	113.80
1	B	149	GLY	CA-C-N	5.91	126.50	119.94
1	B	149	GLY	C-N-CA	5.91	126.50	119.94
1	B	239	PHE	CA-CB-CG	5.85	119.65	113.80
1	A	98	ASP	CA-CB-CG	5.76	118.36	112.60
1	A	67	GLN	CA-C-N	5.74	129.04	120.31
1	A	67	GLN	C-N-CA	5.74	129.04	120.31
1	A	375	LEU	CA-C-N	5.68	127.83	120.44
1	A	375	LEU	C-N-CA	5.68	127.83	120.44
1	A	149	GLY	CA-C-N	5.43	125.97	119.94
1	A	149	GLY	C-N-CA	5.43	125.97	119.94
1	A	141	PHE	CA-CB-CG	5.41	119.21	113.80
1	A	226	ASP	CA-CB-CG	5.33	117.93	112.60
1	A	465	SER	CA-C-N	5.31	127.35	120.44

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	465	SER	C-N-CA	5.31	127.35	120.44
1	B	63	PRO	CA-C-N	5.26	128.06	120.38
1	B	63	PRO	C-N-CA	5.26	128.06	120.38
1	B	141	PHE	CA-CB-CG	5.26	119.06	113.80
1	B	98	ASP	CA-CB-CG	5.20	117.80	112.60
1	B	381	SER	CA-C-N	5.16	131.39	121.54
1	B	381	SER	C-N-CA	5.16	131.39	121.54
1	A	381	SER	CA-C-N	5.13	131.34	121.54
1	A	381	SER	C-N-CA	5.13	131.34	121.54
1	B	465	SER	CA-C-N	5.13	127.11	120.44
1	B	465	SER	C-N-CA	5.13	127.11	120.44
1	B	226	ASP	CA-CB-CG	5.07	117.67	112.60

There are no chirality outliers.

There are no planarity outliers.

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	3136	0	2989	24	0
1	B	3128	0	2995	24	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	B	4	0	6	2	0
4	A	37	0	0	0	0
4	B	45	0	0	0	0
All	All	6352	0	5990	43	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 (43) 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:131:TYR:O	1:A:134:VAL:HG12	1.88	0.73

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:131:TYR:O	1:B:134:VAL:HG12	1.90	0.70
1:B:136:ARG:HA	3:B:1489:EDO:H21	1.77	0.66
1:A:144:ILE:O	1:A:147:LEU:HB2	1.97	0.62
1:B:144:ILE:O	1:B:147:LEU:HB2	1.97	0.62
1:B:395:GLN:HG2	1:B:399:MET:HE2	1.81	0.60
1:A:177:GLU:HG3	1:B:123:LEU:HD13	1.87	0.56
1:A:251:VAL:HG13	1:A:307:LEU:HD22	1.88	0.55
1:A:78:LEU:HD22	1:A:83:GLN:HB3	1.91	0.52
1:A:339:LEU:HA	1:A:342:LEU:HD12	1.91	0.52
1:B:339:LEU:HA	1:B:342:LEU:HD12	1.91	0.52
1:A:437:ALA:HB3	1:A:451:MET:HB2	1.92	0.51
1:B:158:ARG:NH2	1:B:299:GLN:O	2.44	0.51
1:A:240:PHE:HZ	1:A:310:ARG:HG3	1.75	0.51
1:B:51:THR:HA	3:B:1489:EDO:H22	1.95	0.49
1:A:236:ARG:HB3	1:A:238:TYR:CE2	2.50	0.47
1:A:129:LEU:HD21	1:B:129:LEU:HD11	1.97	0.46
1:B:236:ARG:HB3	1:B:238:TYR:CE2	2.50	0.46
1:A:129:LEU:HD11	1:B:129:LEU:HD21	1.96	0.46
1:A:261:ILE:HA	1:A:287:ILE:HD11	1.98	0.46
1:B:255:VAL:HG11	1:B:315:LEU:HD11	1.97	0.45
1:B:261:ILE:HA	1:B:287:ILE:HD11	1.98	0.45
1:B:330:PRO:HA	1:B:451:MET:HG2	1.97	0.45
1:A:437:ALA:CB	1:A:451:MET:HB2	2.47	0.45
1:B:395:GLN:HG3	1:B:435:TRP:CD1	2.52	0.44
1:A:173:PRO:HB2	1:B:123:LEU:HD12	1.99	0.43
1:A:151:VAL:O	1:A:155:VAL:HG23	2.18	0.43
1:A:253:LEU:HD23	1:A:311:VAL:HG21	2.01	0.43
1:B:437:ALA:HB3	1:B:451:MET:HB2	2.00	0.43
1:A:469:LEU:HB3	1:B:56:LEU:HD23	2.00	0.43
1:A:253:LEU:HD11	1:A:288:PHE:HB3	2.00	0.43
1:A:431:TRP:HA	1:A:477:SER:HB3	2.01	0.42
1:A:468:TYR:O	1:A:472:LYS:HA	2.19	0.42
1:B:394:LEU:C	1:B:397:PRO:HD2	2.45	0.42
1:A:240:PHE:CZ	1:A:310:ARG:HG3	2.55	0.42
1:A:223:ASN:HB2	1:A:225:MET:HE3	2.02	0.41
1:A:394:LEU:C	1:A:397:PRO:HD2	2.45	0.41
1:B:222:LYS:HE3	1:B:223:ASN:HD21	1.85	0.41
1:B:468:TYR:O	1:B:472:LYS:HA	2.20	0.41
1:B:158:ARG:HD3	1:B:186:LEU:HD12	2.03	0.41
1:A:395:GLN:HG2	1:A:399:MET:HE2	2.03	0.40
1:B:223:ASN:HB2	1:B:225:MET:HE3	2.02	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:396:THR:HG23	1:B:397:PRO:HD3	2.04	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	370/460 (80%)	356 (96%)	14 (4%)	0	100	100
1	B	411/460 (89%)	395 (96%)	15 (4%)	1 (0%)	43	72
All	All	781/920 (85%)	751 (96%)	29 (4%)	1 (0%)	48	77

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	342	LEU

5.3.2 Protein sidechains [i](#)

There are no protein residues with a non-rotameric sidechain to report in this entry.

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

There are no oligosaccharides in this entry.

5.6 Ligand geometry

Of 3 ligands modelled in this entry, 2 are unknown - leaving 1 for Mogul analysis.

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	EDO	B	1489	-	3,3,3	0.62	0	2,2,2	0.34	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	EDO	B	1489	-	-	1/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	B	1489	EDO	O1-C1-C2-O2

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	1489	EDO	2	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, 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	416/460 (90%)	0.38	19 (4%) 37 29	37, 73, 112, 139	2 (0%)
1	B	414/460 (90%)	0.30	15 (3%) 46 37	36, 71, 110, 142	3 (0%)
All	All	830/920 (90%)	0.34	34 (4%) 41 33	36, 72, 111, 142	5 (0%)

All (34) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	224	TRP	5.2
1	A	343	ASN	4.5
1	A	59	ALA	4.4
1	B	206[A]	CYS	4.4
1	B	274	PRO	4.4
1	A	206[A]	CYS	3.9
1	A	373	GLU	3.1
1	A	-9	GLY	3.0
1	A	114	GLN	3.0
1	A	218	VAL	3.0
1	A	471	SER	2.9
1	A	476	ALA	2.8
1	A	66	GLY	2.8
1	B	217	ALA	2.8
1	B	380	SER	2.7
1	B	382	SER	2.6
1	B	-2	GLN	2.6
1	B	480	VAL	2.5
1	A	380	SER	2.5
1	B	120	ALA	2.5
1	A	275	SER	2.4
1	A	71	PHE	2.3
1	B	109	VAL	2.3
1	B	470	GLY	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	478	GLU	2.2
1	B	487	PHE	2.1
1	A	103	ALA	2.1
1	A	167	LEU	2.1
1	A	273	PRO	2.1
1	B	430	LEU	2.1
1	A	341	LEU	2.1
1	A	227	MET	2.0
1	A	488	GLN	2.0
1	B	282	LYS	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 oligosaccharides 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. 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	B-factors(Å ²)	Q<0.9
3	EDO	B	1489	4/4	0.85	0.17	53,57,59,60	0
2	UNX	A	1490	1/1	0.86	0.19	46,46,46,46	0
2	UNX	B	1490	1/1	0.93	0.30	48,48,48,48	0

6.5 Other polymers [i](#)

There are no such residues in this entry.