



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 03:03 AM UTC

PDB ID : 6XNR / pdb_00006xnr
Title : Crystal structure of Rhagium Mordax antifreeze protein
Authors : Ye, Q.; Eves, R.; Campbell, R.L.; Davies, P.L.
Deposited on : 2020-07-04
Resolution : 2.05 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

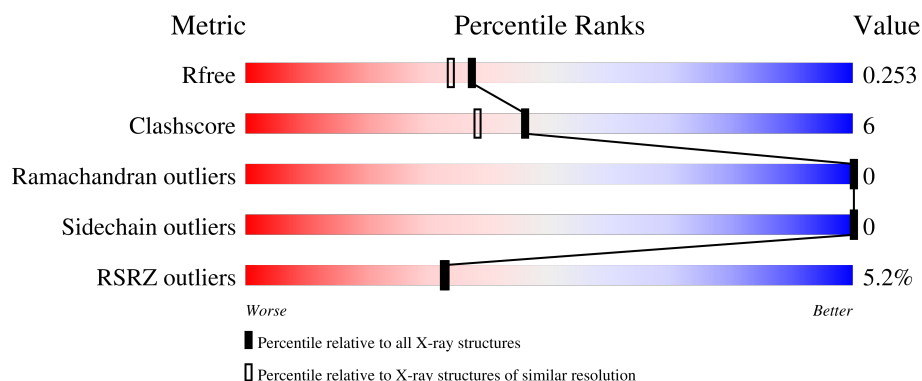
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.05 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	2260 (2.04-2.04)
Clashscore	190562	2333 (2.04-2.04)
Ramachandran outliers	187476	2318 (2.04-2.04)
Sidechain outliers	187428	2318 (2.04-2.04)
RSRZ outliers	180081	2260 (2.04-2.04)

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	AAA	145	4% 88% 8% .
1	BBB	145	7% 84% 11% 5%
1	CCC	145	3% 86% 10% 5%
1	DDD	145	4% 87% 7% 6%
1	EEE	145	7% 88% 8% 5%

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	EDO	BBB	201	-	-	X	-

2 Entry composition [i](#)

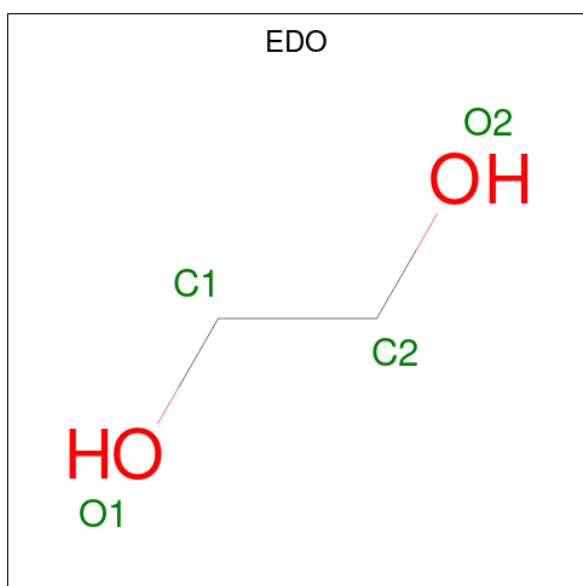
There are 3 unique types of molecules in this entry. The entry contains 4922 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Antifreeze protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	AAA	139	Total	C	N	O	S	0	1	0
			892	519	155	215	3			
1	BBB	138	Total	C	N	O	S	0	0	0
			880	512	154	211	3			
1	CCC	138	Total	C	N	O	S	0	0	0
			880	512	154	211	3			
1	DDD	136	Total	C	N	O	S	0	0	0
			864	501	152	209	2			
1	EEE	138	Total	C	N	O	S	0	0	0
			880	512	154	211	3			

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



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

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	CCC	1	Total	C	O	0	0
			4	2	2		
2	DDD	1	Total	C	O	0	0
			4	2	2		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	AAA	117	Total	O	0	0
			117	117		
3	BBB	116	Total	O	0	0
			116	116		
3	CCC	123	Total	O	0	0
			123	123		
3	DDD	89	Total	O	0	0
			89	89		
3	EEE	69	Total	O	0	0
			69	69		

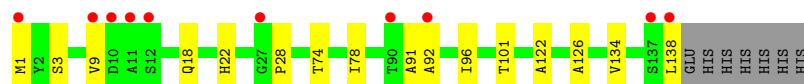
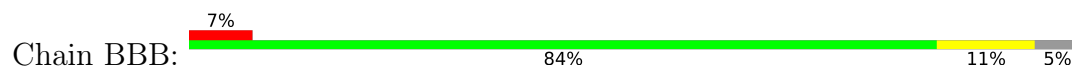
3 Residue-property plots [i](#)

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: Antifreeze protein



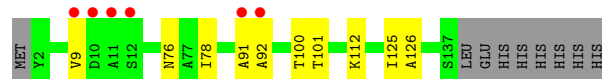
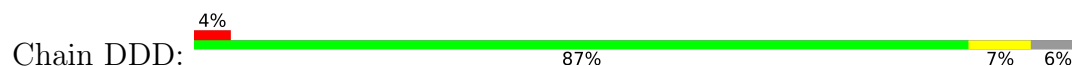
- Molecule 1: Antifreeze protein



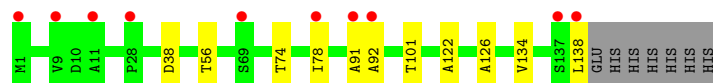
- Molecule 1: Antifreeze protein



- Molecule 1: Antifreeze protein



- Molecule 1: Antifreeze protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 2 ₁ 2 ₁ 2 ₁	Depositor
Cell constants a, b, c, α , β , γ	66.46Å 91.14Å 117.45Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.41 – 2.05 49.41 – 2.05	Depositor EDS
% Data completeness (in resolution range)	99.7 (49.41-2.05) 99.7 (49.41-2.05)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.29 (at 2.05Å)	Xtriage
Refinement program	REFMAC 5.8.0258	Depositor
R, R_{free}	0.213 , 0.251 0.218 , 0.253	Depositor DCC
R_{free} test set	2230 reflections (4.90%)	wwPDB-VP
Wilson B-factor (Å ²)	29.2	Xtriage
Anisotropy	0.757	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 54.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.52$, $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	4922	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.36% 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

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	AAA	1.01	0/899	1.21	0/1237
1	BBB	1.04	0/884	1.19	0/1217
1	CCC	0.99	0/884	1.17	0/1217
1	DDD	0.99	0/868	1.18	0/1196
1	EEE	0.99	0/884	1.20	2/1217 (0.2%)
All	All	1.01	0/4419	1.19	2/6084 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	EEE	91	ALA	CA-C-O	-6.38	113.74	120.63
1	EEE	38	ASP	CA-C-O	-5.13	115.09	120.63

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	AAA	892	0	866	10	0
1	BBB	880	0	855	17	0
1	CCC	880	0	855	10	0
1	DDD	864	0	832	9	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	EEE	880	0	855	9	0
2	BBB	4	0	6	4	0
2	CCC	4	0	6	2	0
2	DDD	4	0	6	3	0
3	AAA	117	0	0	4	0
3	BBB	116	0	0	4	0
3	CCC	123	0	0	1	0
3	DDD	89	0	0	2	0
3	EEE	69	0	0	0	0
All	All	4922	0	4281	50	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 6.

All (50) 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:BBB:9:VAL:O	1:BBB:28:PRO:HA	1.69	0.91
1:BBB:96:ILE:HG23	2:BBB:201:EDO:H12	1.66	0.77
1:DDD:100:THR:HG21	1:EEE:78:ILE:HD11	1.70	0.72
1:BBB:78:ILE:HD11	1:CCC:100:THR:HG21	1.68	0.72
1:BBB:74:THR:OG1	2:CCC:301:EDO:H12	1.94	0.66
1:BBB:138:LEU:C	3:BBB:347:HOH:O	2.39	0.65
1:BBB:1:MET:HE2	3:BBB:416:HOH:O	1.96	0.64
1:BBB:74:THR:OG1	2:BBB:201:EDO:H21	1.98	0.64
1:DDD:125:ILE:HD11	1:EEE:56:THR:CG2	2.27	0.63
1:BBB:74:THR:OG1	2:CCC:301:EDO:C1	2.47	0.63
1:BBB:78:ILE:CD1	1:CCC:100:THR:HG21	2.30	0.60
1:BBB:96:ILE:CG2	2:BBB:201:EDO:H12	2.33	0.57
1:BBB:122:ALA:HB3	1:BBB:134:VAL:HG22	1.87	0.56
1:BBB:22:HIS:HD2	3:BBB:400:HOH:O	1.90	0.55
1:DDD:100:THR:HG21	1:EEE:78:ILE:CD1	2.36	0.54
1:AAA:101:THR:HA	1:AAA:126:ALA:O	2.08	0.53
1:DDD:101:THR:HA	1:DDD:126:ALA:O	2.09	0.52
1:AAA:122:ALA:HB3	1:AAA:134:VAL:HG22	1.91	0.52
1:CCC:10:ASP:OD1	1:CCC:12:SER:HB3	2.09	0.52
1:BBB:101:THR:HA	1:BBB:126:ALA:O	2.09	0.52
1:CCC:101:THR:HA	1:CCC:126:ALA:O	2.10	0.52
1:AAA:112:LYS:HE2	3:AAA:215:HOH:O	2.10	0.52
1:DDD:91:ALA:O	1:DDD:92:ALA:HB3	2.09	0.51
1:EEE:101:THR:HA	1:EEE:126:ALA:O	2.09	0.51

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:DDD:76:ASN:HB3	1:DDD:78:ILE:HD11	1.93	0.51
1:BBB:96:ILE:HG23	2:BBB:201:EDO:C1	2.40	0.51
1:AAA:112:LYS:CE	3:AAA:215:HOH:O	2.59	0.51
2:DDD:201:EDO:H21	1:EEE:74:THR:CB	2.41	0.51
3:BBB:323:HOH:O	1:CCC:123:THR:HG21	2.12	0.49
1:AAA:1:MET:HE2	3:AAA:317:HOH:O	2.12	0.49
1:BBB:91:ALA:O	1:BBB:92:ALA:HB3	2.11	0.49
2:DDD:201:EDO:H21	1:EEE:74:THR:HB	1.95	0.49
1:EEE:122:ALA:HB3	1:EEE:134:VAL:HG22	1.95	0.49
1:CCC:115:SER:HA	1:CCC:135:THR:O	2.12	0.48
1:CCC:91:ALA:O	1:CCC:92:ALA:HB3	2.13	0.48
1:EEE:92:ALA:HB3	1:EEE:138:LEU:HB3	1.97	0.47
1:CCC:76:ASN:HB3	3:CCC:403:HOH:O	2.13	0.47
1:AAA:34:GLY:HA2	1:AAA:55:SER:O	2.16	0.45
1:DDD:112:LYS:HE3	3:DDD:356:HOH:O	2.16	0.44
1:AAA:3[B]:SER:H	1:AAA:18:GLN:NE2	2.15	0.44
1:AAA:3[A]:SER:H	1:AAA:18:GLN:NE2	2.15	0.44
1:DDD:78:ILE:N	1:DDD:78:ILE:HD12	2.33	0.44
1:BBB:3:SER:H	1:BBB:18:GLN:NE2	2.16	0.43
1:DDD:9:VAL:HA	3:DDD:337:HOH:O	2.19	0.42
1:BBB:122:ALA:HB3	1:BBB:134:VAL:CG2	2.49	0.41
1:AAA:22:HIS:HE1	3:AAA:286:HOH:O	2.03	0.41
1:CCC:114:VAL:O	1:CCC:134:VAL:HA	2.19	0.41
2:DDD:201:EDO:C2	1:EEE:74:THR:HB	2.51	0.41
1:AAA:122:ALA:HB3	1:AAA:134:VAL:CG2	2.51	0.40
1:CCC:98:SER:O	1:CCC:123:THR:HA	2.22	0.40

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	AAA	138/145 (95%)	137 (99%)	1 (1%)	0	100	100
1	BBB	136/145 (94%)	131 (96%)	5 (4%)	0	100	100
1	CCC	136/145 (94%)	132 (97%)	4 (3%)	0	100	100
1	DDD	134/145 (92%)	132 (98%)	2 (2%)	0	100	100
1	EEE	136/145 (94%)	135 (99%)	1 (1%)	0	100	100
All	All	680/725 (94%)	667 (98%)	13 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	AAA	94/99 (95%)	94 (100%)	0	100	100
1	BBB	92/99 (93%)	92 (100%)	0	100	100
1	CCC	92/99 (93%)	92 (100%)	0	100	100
1	DDD	90/99 (91%)	90 (100%)	0	100	100
1	EEE	92/99 (93%)	92 (100%)	0	100	100
All	All	460/495 (93%)	460 (100%)	0	100	100

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

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

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 oligosaccharides in this entry.

5.6 Ligand geometry

3 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	EDO	DDD	201	-	3,3,3	0.15	0	2,2,2	0.17	0
2	EDO	CCC	301	-	3,3,3	0.22	0	2,2,2	0.68	0
2	EDO	BBB	201	-	3,3,3	0.11	0	2,2,2	0.30	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	EDO	DDD	201	-	-	0/1/1/1	-
2	EDO	CCC	301	-	-	0/1/1/1	-
2	EDO	BBB	201	-	-	0/1/1/1	-

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.

3 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	DDD	201	EDO	3	0
2	CCC	301	EDO	2	0

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Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	BBB	201	EDO	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 ⓘ

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	AAA	139/145 (95%)	0.02	6 (4%) 40 40	19, 28, 44, 60	1 (0%)
1	BBB	138/145 (95%)	0.21	10 (7%) 21 21	23, 30, 43, 56	0
1	CCC	138/145 (95%)	0.11	4 (2%) 53 55	24, 29, 42, 53	0
1	DDD	136/145 (93%)	0.41	6 (4%) 39 39	30, 39, 53, 57	0
1	EEE	138/145 (95%)	0.68	10 (7%) 21 21	32, 42, 61, 67	0
All	All	689/725 (95%)	0.28	36 (5%) 33 33	19, 34, 52, 67	1 (0%)

All (36) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	EEE	138	LEU	4.5
1	DDD	9	VAL	3.9
1	CCC	138	LEU	3.7
1	CCC	12	SER	3.6
1	BBB	27	GLY	3.4
1	DDD	11	ALA	3.4
1	BBB	9	VAL	3.3
1	EEE	137	SER	3.3
1	EEE	11	ALA	3.2
1	BBB	11	ALA	3.1
1	DDD	10	ASP	3.1
1	BBB	92	ALA	3.1
1	AAA	92	ALA	2.9
1	BBB	12	SER	2.8
1	BBB	10	ASP	2.7
1	EEE	1	MET	2.5
1	AAA	138	LEU	2.5
1	BBB	1	MET	2.5
1	DDD	12	SER	2.4
1	EEE	9	VAL	2.4

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Mol	Chain	Res	Type	RSRZ
1	EEE	92	ALA	2.3
1	BBB	138	LEU	2.3
1	AAA	121	THR	2.3
1	AAA	10	ASP	2.3
1	EEE	91	ALA	2.3
1	DDD	92	ALA	2.2
1	EEE	69	SER	2.2
1	EEE	28	PRO	2.2
1	AAA	91	ALA	2.2
1	DDD	91	ALA	2.2
1	EEE	78	ILE	2.2
1	CCC	11	ALA	2.2
1	CCC	9	VAL	2.1
1	AAA	139	GLU	2.1
1	BBB	90	THR	2.0
1	BBB	137	SER	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($\text{\AA}^2$)	Q<0.9
2	EDO	BBB	201	4/4	0.81	0.20	48,49,50,54	0
2	EDO	CCC	301	4/4	0.83	0.17	34,39,43,46	0
2	EDO	DDD	201	4/4	0.83	0.18	51,51,54,54	0

6.5 Other polymers [i](#)

There are no such residues in this entry.