



# Full wwPDB X-ray Structure Validation Report ⓘ

Jun 12, 2024 – 02:57 PM EDT

PDB ID : 3I83  
Title : Crystal structure of 2-dehydropantoate 2-reductase from *Methylococcus capsulatus*  
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Deposited on : 2009-07-09  
Resolution : 1.90 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](mailto: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>.

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

MolProbity : 4.02b-467  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 1.20.1  
EDS : 2.36.2  
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) : 2.36.2

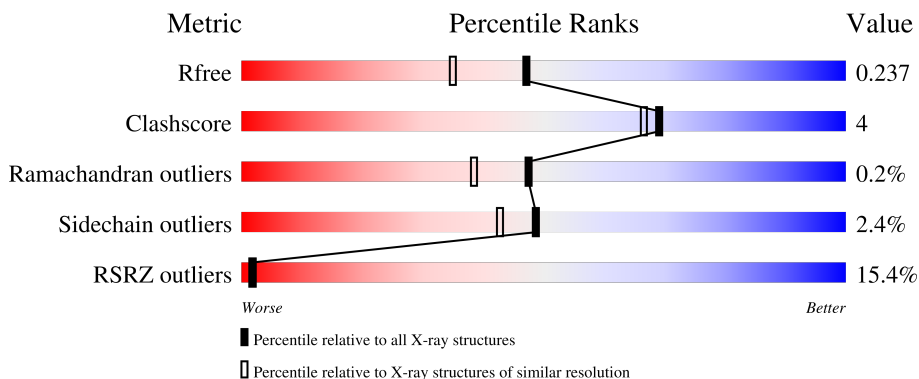
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.90 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	6207 (1.90-1.90)
Clashscore	141614	6847 (1.90-1.90)
Ramachandran outliers	138981	6760 (1.90-1.90)
Sidechain outliers	138945	6760 (1.90-1.90)
RSRZ outliers	127900	6082 (1.90-1.90)

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  $\geq 3$ , 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	320	 9% 88% 8%
1	B	320	 20% 82% 8% 10%

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 4702 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 2-dehydropantoate 2-reductase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	310	2309	1468	396	435	10	0	1	0
1	B	287	2130	1359	365	396	10	0	1	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	MET	-	expression tag	UNP Q604L6
A	0	SER	-	expression tag	UNP Q604L6
A	1	LEU	-	expression tag	UNP Q604L6
A	311	GLU	-	expression tag	UNP Q604L6
A	312	GLY	-	expression tag	UNP Q604L6
A	313	HIS	-	expression tag	UNP Q604L6
A	314	HIS	-	expression tag	UNP Q604L6
A	315	HIS	-	expression tag	UNP Q604L6
A	316	HIS	-	expression tag	UNP Q604L6
A	317	HIS	-	expression tag	UNP Q604L6
A	318	HIS	-	expression tag	UNP Q604L6
B	-1	MET	-	expression tag	UNP Q604L6
B	0	SER	-	expression tag	UNP Q604L6
B	1	LEU	-	expression tag	UNP Q604L6
B	311	GLU	-	expression tag	UNP Q604L6
B	312	GLY	-	expression tag	UNP Q604L6
B	313	HIS	-	expression tag	UNP Q604L6
B	314	HIS	-	expression tag	UNP Q604L6
B	315	HIS	-	expression tag	UNP Q604L6
B	316	HIS	-	expression tag	UNP Q604L6
B	317	HIS	-	expression tag	UNP Q604L6
B	318	HIS	-	expression tag	UNP Q604L6

- Molecule 2 is ACETIC ACID (three-letter code: ACY) (formula: C<sub>2</sub>H<sub>4</sub>O<sub>2</sub>).



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

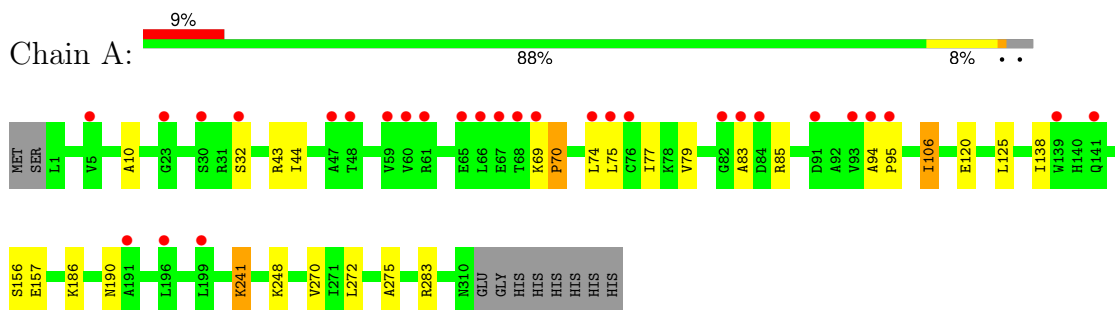
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	167	Total O 167 167	0	0
3	B	92	Total O 92 92	0	0

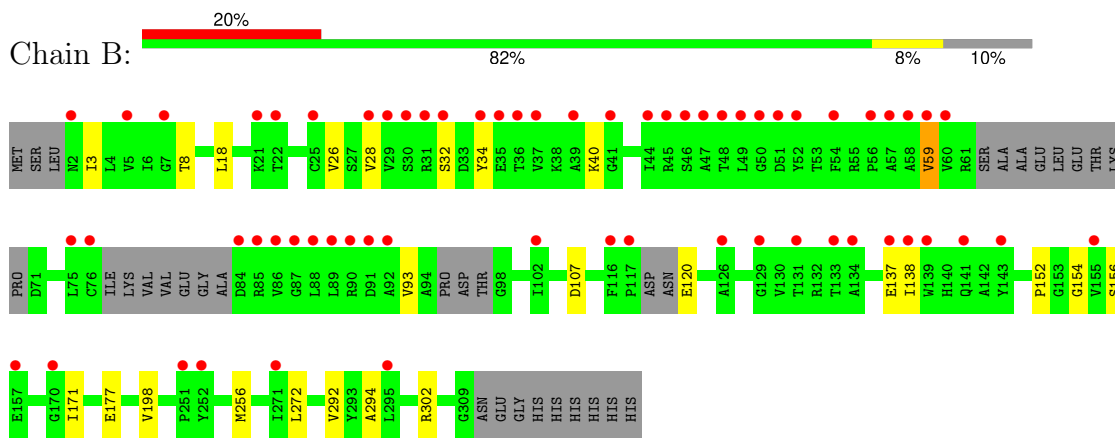
### 3 Residue-property plots [i](#)

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: 2-dehydropantoate 2-reductase



- Molecule 1: 2-dehydropantoate 2-reductase



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	75.85Å 79.18Å 100.63Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 1.90 28.60 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.4 (20.00-1.90) 99.4 (28.60-1.90)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	0.10	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.15 (at 1.91Å)	Xtrriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.192 , 0.227 0.202 , 0.237	Depositor DCC
$R_{free}$ test set	2355 reflections (4.89%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	22.7	Xtrriage
Anisotropy	0.188	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37 , 54.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.029 for k,h,-l	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	4702	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	27.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.37% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>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: ACY

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	0.83	0/2353	0.79	2/3204 (0.1%)
1	B	0.80	2/2168 (0.1%)	0.72	1/2945 (0.0%)
All	All	0.82	2/4521 (0.0%)	0.76	3/6149 (0.0%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	59	VAL	CB-CG2	6.28	1.66	1.52
1	B	294	ALA	CA-CB	5.24	1.63	1.52

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	272	LEU	CB-CG-CD2	-6.34	100.22	111.00
1	A	241	LYS	CD-CE-NZ	5.15	123.54	111.70
1	B	302	ARG	NE-CZ-NH1	-5.06	117.77	120.30

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	2309	0	2333	21	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	2130	0	2144	12	0
2	A	4	0	3	0	0
3	A	167	0	0	0	0
3	B	92	0	0	1	0
All	All	4702	0	4480	33	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 (33) 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:106:ILE:HD11	1:A:275:ALA:HB2	1.60	0.81
1:A:69:LYS:HG2	1:A:70:PRO:CD	2.21	0.70
1:B:152:PRO:O	3:B:364:HOH:O	2.12	0.66
1:A:69:LYS:HD3	1:A:94:ALA:HB2	1.78	0.66
1:A:79:VAL:HB	1:A:270:VAL:HG11	1.80	0.64
1:A:69:LYS:HG2	1:A:70:PRO:HD2	1.80	0.63
1:A:77:ILE:HD12	1:A:83:ALA:HB1	1.83	0.59
1:B:198:VAL:HG21	1:B:256:MET:HG2	1.87	0.56
1:B:8:THR:HG22	1:B:28:VAL:HG11	1.88	0.55
1:B:272:LEU:HD21	1:B:292:VAL:HG12	1.88	0.53
1:A:69:LYS:HG2	1:A:70:PRO:HD3	1.91	0.52
1:B:3:ILE:HB	1:B:26:VAL:HG22	1.92	0.50
1:A:106:ILE:HD11	1:A:275:ALA:CB	2.37	0.49
1:A:125:LEU:HD11	1:A:186:LYS:HD3	1.96	0.48
1:A:77:ILE:HD11	1:A:85:ARG:HG2	1.96	0.47
1:A:69:LYS:CG	1:A:70:PRO:HD3	2.44	0.47
1:B:120:GLU:OE1	1:B:156:SER:OG	2.26	0.47
1:B:8:THR:CG2	1:B:28:VAL:HG11	2.45	0.46
1:B:154:GLY:HA2	1:B:177:GLU:HG2	1.97	0.46
1:A:77:ILE:HD11	1:A:85:ARG:CG	2.46	0.46
1:B:18:LEU:CD1	1:B:171:ILE:HD13	2.46	0.46
1:A:69:LYS:CG	1:A:70:PRO:CD	2.94	0.45
1:A:186:LYS:HG2	1:A:190[A]:ASN:ND2	2.32	0.45
1:A:120:GLU:OE1	1:A:156:SER:OG	2.23	0.44
1:B:34:TYR:CE1	1:B:59:VAL:HG12	2.53	0.44
1:A:106:ILE:CD1	1:A:275:ALA:HB2	2.40	0.43
1:B:137:GLU:C	1:B:138:ILE:HD13	2.39	0.43
1:A:10:ALA:HA	1:A:138:ILE:HD12	2.01	0.42
1:A:94:ALA:HB1	1:A:95:PRO:HD2	2.02	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:44:ILE:CD1	1:A:138:ILE:HB	2.50	0.41
1:A:248:LYS:HD2	1:A:248:LYS:HA	1.82	0.41
1:B:137:GLU:O	1:B:138:ILE:HD13	2.20	0.41
1:A:75:LEU:HD21	1:A:85:ARG:HG2	2.02	0.41

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	309/320 (97%)	298 (96%)	11 (4%)	0	100	100
1	B	278/320 (87%)	255 (92%)	22 (8%)	1 (0%)	34	24
All	All	587/640 (92%)	553 (94%)	33 (6%)	1 (0%)	47	38

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	93	VAL

### 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	239/254 (94%)	231 (97%)	8 (3%)	38	29

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	218/254 (86%)	215 (99%)	3 (1%)	67	65
All	All	457/508 (90%)	446 (98%)	11 (2%)	49	43

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	32	SER
1	A	43	ARG
1	A	70	PRO
1	A	74	LEU
1	A	106	ILE
1	A	157	GLU
1	A	241	LYS
1	A	283	ARG
1	B	32	SER
1	B	40	LYS
1	B	107	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	2	ASN
1	A	264	GLN
1	B	24	HIS

### 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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

1 ligand is 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	ACY	A	319	-	3,3,3	0.78	0	3,3,3	0.64	0

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	310/320 (96%)	0.53	29 (9%) <b>8</b> <b>9</b>	13, 29, 44, 58	0
1	B	287/320 (89%)	1.12	63 (21%) <b>0</b> <b>0</b>	12, 23, 43, 54	0
All	All	597/640 (93%)	0.82	92 (15%) <b>2</b> <b>2</b>	12, 25, 44, 58	0

All (92) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	47	ALA	10.9
1	B	37	VAL	10.2
1	B	30	SER	9.8
1	B	41	GLY	7.3
1	B	48	THR	6.8
1	B	91	ASP	6.4
1	B	49	LEU	6.4
1	B	60	VAL	6.4
1	B	58	ALA	5.7
1	B	51	ASP	5.3
1	B	31	ARG	5.0
1	B	84	ASP	4.9
1	A	68	THR	4.9
1	B	29	VAL	4.8
1	B	39	ALA	4.6
1	A	82	GLY	4.5
1	B	88	LEU	4.4
1	B	86	VAL	4.4
1	B	89	LEU	4.2
1	A	83	ALA	4.1
1	B	76	CYS	4.0
1	A	66	LEU	3.9
1	A	67	GLU	3.8
1	A	139	TRP	3.6

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	A	95	PRO	3.6
1	B	50	GLY	3.4
1	B	57	ALA	3.4
1	B	139	TRP	3.3
1	B	141	GLN	3.3
1	B	28	VAL	3.3
1	B	170	GLY	3.2
1	A	61	ARG	3.1
1	A	74	LEU	3.1
1	B	102	ILE	3.1
1	B	131	THR	3.1
1	A	59	VAL	3.0
1	B	92	ALA	3.0
1	B	21	LYS	2.9
1	B	133	THR	2.9
1	B	45	ARG	2.9
1	B	87	GLY	2.9
1	A	47	ALA	2.9
1	A	84	ASP	2.8
1	B	90	ARG	2.8
1	A	94	ALA	2.8
1	B	32	SER	2.8
1	B	54	PHE	2.8
1	B	25	CYS	2.7
1	B	56	PRO	2.7
1	B	143	TYR	2.7
1	B	75	LEU	2.6
1	A	69	LYS	2.6
1	A	91	ASP	2.6
1	B	34	TYR	2.6
1	B	36	THR	2.6
1	B	129	GLY	2.6
1	B	44	ILE	2.6
1	B	35	GLU	2.6
1	A	191	ALA	2.5
1	B	46	SER	2.5
1	B	155	VAL	2.5
1	A	141	GLN	2.4
1	B	134	ALA	2.4
1	A	30	SER	2.4
1	A	65	GLU	2.4
1	B	116	PHE	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	137	GLU	2.3
1	A	60	VAL	2.3
1	B	157	GLU	2.3
1	B	22	THR	2.3
1	B	138	ILE	2.3
1	B	7	GLY	2.2
1	A	48	THR	2.2
1	B	251	PRO	2.2
1	A	5	VAL	2.2
1	A	76	CYS	2.1
1	B	85	ARG	2.1
1	A	23	GLY	2.1
1	B	2	ASN	2.1
1	B	126	ALA	2.1
1	A	196	LEU	2.1
1	B	295	LEU	2.1
1	A	32	SER	2.1
1	B	271	ILE	2.1
1	A	199	LEU	2.1
1	B	52	TYR	2.1
1	B	5	VAL	2.1
1	B	59	VAL	2.0
1	B	117	PRO	2.0
1	B	252	TYR	2.0
1	A	93	VAL	2.0
1	A	75	LEU	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 monosaccharides 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, 95<sup>th</sup> 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	ACY	A	319	4/4	0.94	0.12	26,26,26,27	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.