



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 19, 2016 – 09:49 PM GMT

PDB ID : 5BQ3  
Title : Crystal structure of a sugar ABC transporter (ACTODO\_00688) from *Actinomyces odontolyticus* ATCC 17982 at 2.60 Å resolution  
Authors : Joint Center for Structural Genomics (JCSG)  
Deposited on : 2015-05-28  
Resolution : 2.60 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  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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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 : unknown  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026982  
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) : rb-20026982

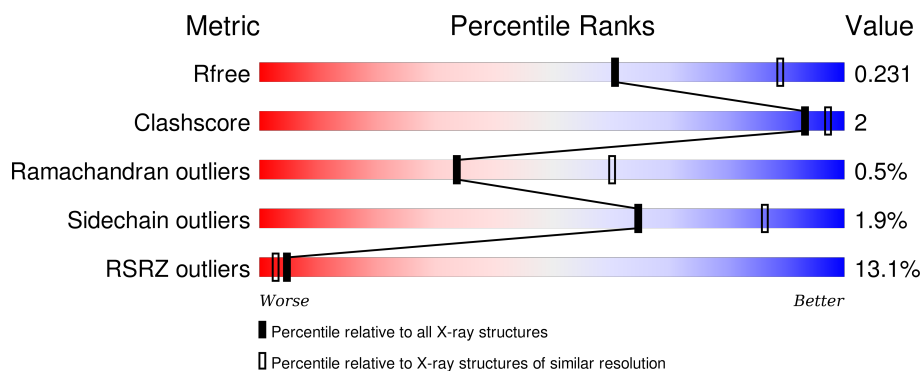
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.60 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	2328 (2.60-2.60)
Clashscore	102246	2679 (2.60-2.60)
Ramachandran outliers	100387	2635 (2.60-2.60)
Sidechain outliers	100360	2635 (2.60-2.60)
RSRZ outliers	91569	2334 (2.60-2.60)

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  $\geq 3$ , 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	332	<div> <div>2%</div> <div>87%</div> <div>7%</div> <div>6%</div> </div>
1	B	332	<div> <div>2%</div> <div>88%</div> <div>7%</div> <div>6%</div> </div>
1	C	332	<div> <div>7%</div> <div>86%</div> <div>7%</div> <div>6%</div> </div>
1	D	332	<div> <div>37%</div> <div>89%</div> <div>5%</div> <div>6%</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 Rhamnose ABC transporter, rhamnose-binding protein.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	313	Total	C	N	O	S	Se	0	0	0
			2310	1445	385	473	2	5			
1	B	313	Total	C	N	O	S	Se	0	0	0
			2307	1444	385	471	2	5			
1	C	312	Total	C	N	O	S	Se	0	0	0
			2302	1441	384	470	2	5			
1	D	312	Total	C	N	O	S	Se	0	0	0
			2298	1438	383	470	2	5			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	GLY	-	leader sequence	UNP A7BAM4
B	0	GLY	-	leader sequence	UNP A7BAM4
C	0	GLY	-	leader sequence	UNP A7BAM4
D	0	GLY	-	leader sequence	UNP A7BAM4

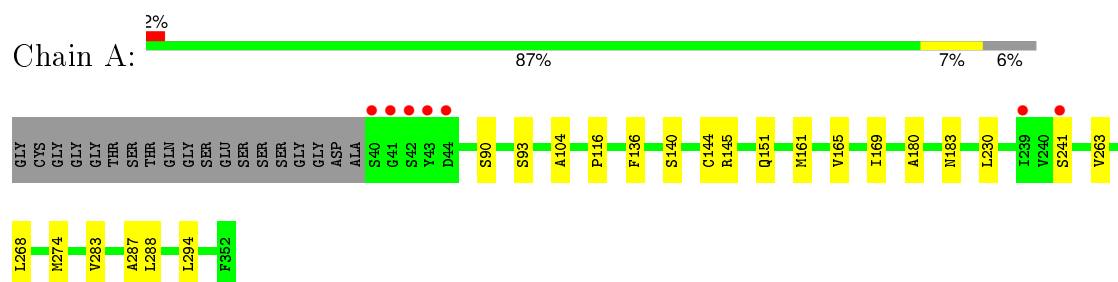
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	112	Total	O	0	0
			112	112		
2	B	73	Total	O	0	0
			73	73		
2	C	33	Total	O	0	0
			33	33		
2	D	14	Total	O	0	0
			14	14		

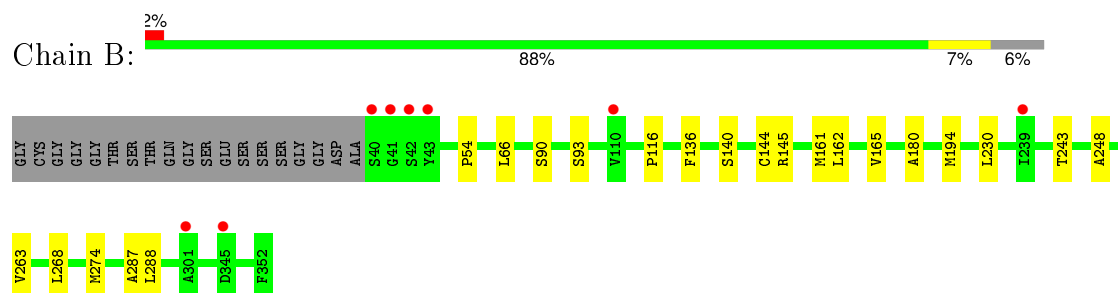
### 3 Residue-property plots [i](#)

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.

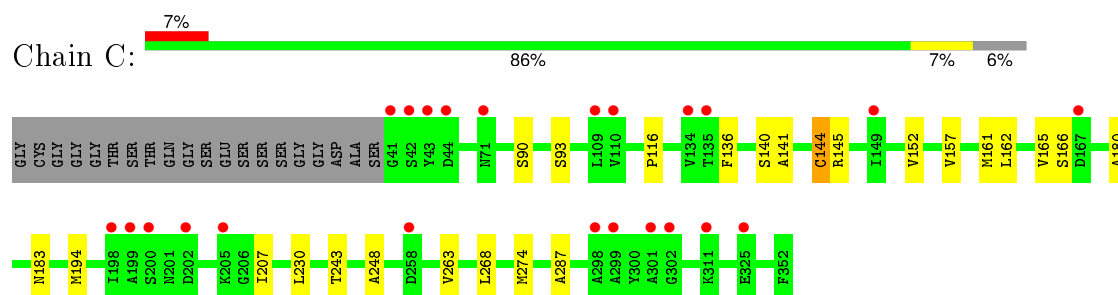
- Molecule 1: Rhamnose ABC transporter, rhamnose-binding protein



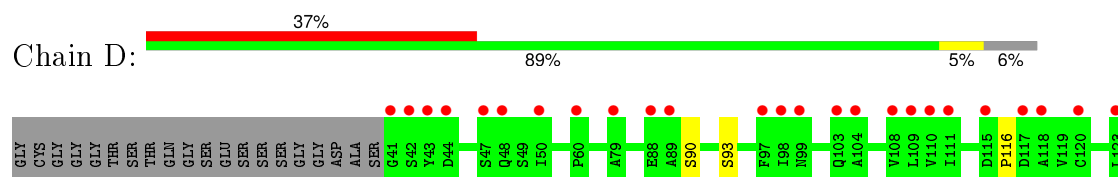
- Molecule 1: Rhamnose ABC transporter, rhamnose-binding protein

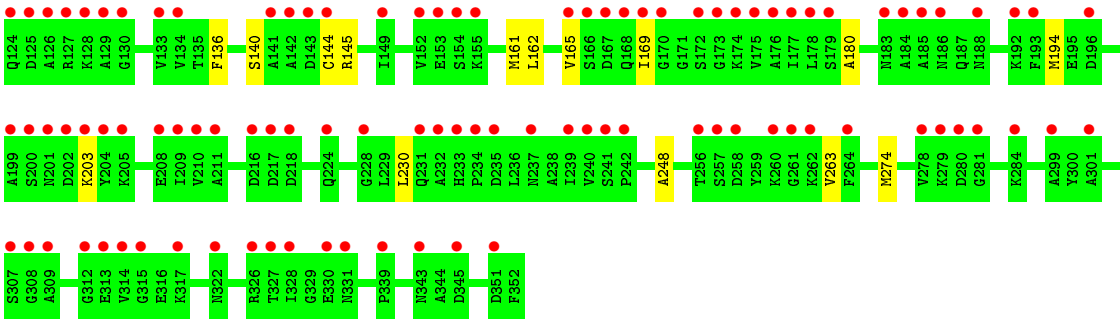


- Molecule 1: Rhamnose ABC transporter, rhamnose-binding protein



- Molecule 1: Rhamnose ABC transporter, rhamnose-binding protein





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	84.78Å 83.28Å 104.22Å 90.00° 111.87° 90.00°	Depositor
Resolution (Å)	19.94 – 2.60 19.94 – 2.60	Depositor EDS
% Data completeness (in resolution range)	96.9 (19.94-2.60) 96.9 (19.94-2.60)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.68 (at 2.59Å)	Xtriage
Refinement program	BUSTER 2.10.2	Depositor
R, $R_{free}$	0.207 , 0.219 0.218 , 0.231	Depositor DCC
$R_{free}$ test set	2018 reflections (5.28%)	DCC
Wilson B-factor (Å <sup>2</sup> )	51.7	Xtriage
Anisotropy	0.213	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 44.5	EDS
Estimated twinning fraction	0.054 for h,-k,-h-l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	1 of 40252 reflections (0.002%)	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	9449	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	70.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.31% 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, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

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	0.39	0/2340	0.57	0/3165
1	B	0.40	0/2337	0.56	0/3161
1	C	0.40	0/2332	0.56	0/3154
1	D	0.41	0/2328	0.56	0/3150
All	All	0.40	0/9337	0.56	0/12630

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	2310	0	2247	9	0
1	B	2307	0	2245	8	0
1	C	2302	0	2243	10	0
1	D	2298	0	2232	8	0
2	A	112	0	0	0	0
2	B	73	0	0	0	0
2	C	33	0	0	0	0
2	D	14	0	0	0	0
All	All	9449	0	8967	34	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 2.

All (34) 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:C:116:PRO:HA	1:C:140:SER:HA	1.82	0.59
1:C:248:ALA:HA	1:C:274:MSE:HE1	1.85	0.58
1:B:248:ALA:HA	1:B:274:MSE:HE1	1.86	0.57
1:D:116:PRO:HA	1:D:140:SER:HA	1.86	0.57
1:D:248:ALA:HA	1:D:274:MSE:HE1	1.87	0.57
1:A:116:PRO:HA	1:A:140:SER:HA	1.87	0.56
1:B:116:PRO:HA	1:B:140:SER:HA	1.86	0.56
1:B:90:SER:HB3	1:B:93:SER:HB3	1.89	0.54
1:A:90:SER:HB3	1:A:93:SER:HB3	1.89	0.54
1:D:90:SER:HB2	1:D:93:SER:HB3	1.88	0.54
1:C:90:SER:HB3	1:C:93:SER:HB3	1.89	0.54
1:C:161:MSE:O	1:C:165:VAL:HG23	2.12	0.49
1:B:162:LEU:HD11	1:B:194:MSE:HA	1.96	0.48
1:C:166:SER:HB2	1:C:207:ILE:HD11	1.97	0.47
1:C:268:LEU:HA	1:C:287:ALA:O	2.16	0.46
1:A:268:LEU:HA	1:A:287:ALA:O	2.17	0.45
1:B:268:LEU:HA	1:B:287:ALA:O	2.17	0.45
1:D:162:LEU:HD11	1:D:194:MSE:HA	1.99	0.43
1:C:162:LEU:HD11	1:C:194:MSE:HA	2.00	0.42
1:D:161:MSE:O	1:D:165:VAL:HG23	2.19	0.42
1:A:161:MSE:O	1:A:165:VAL:HG23	2.20	0.41
1:B:161:MSE:O	1:B:165:VAL:HG23	2.20	0.41
1:A:104:ALA:HB2	1:D:203:LYS:HB2	2.02	0.41
1:A:151:GLN:HG3	1:A:294:LEU:HD13	2.01	0.41
1:A:165:VAL:O	1:A:169:ILE:HG12	2.20	0.41
1:C:157:VAL:HG12	1:C:161:MSE:HE2	2.03	0.41
1:D:230:LEU:HD11	1:D:263:VAL:HG21	2.03	0.41
1:B:230:LEU:HD11	1:B:263:VAL:HG21	2.03	0.41
1:A:274:MSE:HE1	1:A:283:VAL:HG21	2.03	0.41
1:C:141:ALA:HB3	1:C:144:CYS:SG	2.61	0.40
1:C:230:LEU:HD11	1:C:263:VAL:HG21	2.02	0.40
1:D:165:VAL:O	1:D:169:ILE:HG12	2.21	0.40
1:B:54:PRO:HG3	1:B:66:LEU:HD11	2.03	0.40
1:A:230:LEU:HD11	1:A:263:VAL:HG21	2.03	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	311/332 (94%)	301 (97%)	8 (3%)	2 (1%)	30	56
1	B	311/332 (94%)	301 (97%)	8 (3%)	2 (1%)	30	56
1	C	310/332 (93%)	300 (97%)	9 (3%)	1 (0%)	46	72
1	D	310/332 (93%)	300 (97%)	9 (3%)	1 (0%)	46	72
All	All	1242/1328 (94%)	1202 (97%)	34 (3%)	6 (0%)	34	60

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	180	ALA
1	D	180	ALA
1	A	180	ALA
1	A	288	LEU
1	B	180	ALA
1	B	288	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	243/252 (96%)	238 (98%)	5 (2%)	61	85
1	B	242/252 (96%)	238 (98%)	4 (2%)	68	88
1	C	242/252 (96%)	236 (98%)	6 (2%)	55	81
1	D	241/252 (96%)	238 (99%)	3 (1%)	78	92

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	968/1008 (96%)	950 (98%)	18 (2%)	65	86

All (18) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	136	PHE
1	A	144	CYS
1	A	145	ARG
1	A	183	ASN
1	A	241	SER
1	B	136	PHE
1	B	144	CYS
1	B	145	ARG
1	B	243	THR
1	C	136	PHE
1	C	144	CYS
1	C	145	ARG
1	C	152	VAL
1	C	183	ASN
1	C	243	THR
1	D	136	PHE
1	D	144	CYS
1	D	145	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	168	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 [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

There are no ligands in this entry.

## 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	308/332 (92%)	-0.01	7 (2%) 64 57	27, 44, 65, 93	0
1	B	308/332 (92%)	0.11	8 (2%) 59 53	34, 56, 79, 96	0
1	C	307/332 (92%)	0.42	23 (7%) 17 12	39, 66, 104, 129	0
1	D	307/332 (92%)	1.90	123 (40%) 0 0	68, 110, 143, 170	0
All	All	1230/1328 (92%)	0.61	161 (13%) 5 3	27, 62, 129, 170	0

All (161) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	144	CYS	10.0
1	B	40	SER	8.6
1	C	42	SER	8.4
1	B	42	SER	8.4
1	D	42	SER	8.1
1	D	170	GLY	7.4
1	D	110	VAL	6.0
1	D	124	GLN	5.7
1	A	42	SER	5.6
1	D	239	ILE	5.6
1	A	40	SER	5.4
1	B	41	GLY	5.4
1	D	331	ASN	5.4
1	D	143	ASP	5.4
1	D	120	CYS	5.2
1	D	262	LYS	5.1
1	D	167	ASP	5.1
1	D	43	TYR	5.0
1	D	183	ASN	4.9
1	D	240	VAL	4.9
1	D	153	GLU	4.8

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Mol	Chain	Res	Type	RSRZ
1	D	44	ASP	4.7
1	D	205	LYS	4.7
1	D	128	LYS	4.7
1	D	241	SER	4.6
1	D	103	GLN	4.6
1	D	345	ASP	4.5
1	D	234	PRO	4.5
1	D	174	LYS	4.4
1	C	200	SER	4.4
1	D	177	ILE	4.4
1	D	129	ALA	4.2
1	D	188	ASN	4.2
1	D	109	LEU	4.2
1	D	169	ILE	4.1
1	D	142	ALA	4.1
1	D	99	ASN	4.1
1	D	258	ASP	4.1
1	D	134	VAL	4.1
1	D	202	ASP	4.0
1	D	130	GLY	4.0
1	D	330	GLU	4.0
1	D	199	ALA	4.0
1	D	232	ALA	4.0
1	D	185	ALA	3.9
1	D	235	ASP	3.8
1	D	104	ALA	3.7
1	D	176	ALA	3.7
1	D	126	ALA	3.6
1	D	231	GLN	3.6
1	D	308	GLY	3.6
1	D	184	ALA	3.6
1	D	178	LEU	3.6
1	D	125	ASP	3.5
1	C	199	ALA	3.5
1	D	201	ASN	3.5
1	D	98	ILE	3.5
1	D	48	GLN	3.5
1	D	208	GLU	3.4
1	D	79	ALA	3.4
1	D	133	VAL	3.4
1	C	134	VAL	3.3
1	D	115	ASP	3.3

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Mol	Chain	Res	Type	RSRZ
1	D	141	ALA	3.3
1	D	88	GLU	3.3
1	D	261	GLY	3.3
1	D	314	VAL	3.3
1	D	284	LYS	3.3
1	D	204	TYR	3.3
1	D	168	GLN	3.3
1	D	327	THR	3.2
1	D	315	GLY	3.2
1	B	43	TYR	3.2
1	D	200	SER	3.2
1	C	301	ALA	3.2
1	C	44	ASP	3.1
1	D	280	ASP	3.1
1	C	299	ALA	3.1
1	C	43	TYR	3.1
1	D	186	ASN	3.0
1	D	41	GLY	3.0
1	D	281	GLY	3.0
1	D	175	VAL	3.0
1	D	312	GLY	3.0
1	A	43	TYR	2.9
1	D	172	SER	2.9
1	A	44	ASP	2.9
1	D	217	ASP	2.9
1	D	210	VAL	2.9
1	D	278	VAL	2.9
1	D	155	LYS	2.8
1	A	41	GLY	2.8
1	D	111	ILE	2.8
1	D	299	ALA	2.8
1	C	302	GLY	2.8
1	D	256	THR	2.8
1	D	108	VAL	2.8
1	D	317	LYS	2.7
1	D	233	HIS	2.7
1	D	257	SER	2.7
1	C	202	ASP	2.7
1	C	110	VAL	2.7
1	D	179	SER	2.7
1	D	343	ASN	2.6
1	D	351	ASP	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	239	ILE	2.6
1	D	242	PRO	2.6
1	D	193	PHE	2.5
1	D	313	GLU	2.5
1	D	322	ASN	2.5
1	C	135	THR	2.5
1	C	149	ILE	2.5
1	C	198	ILE	2.5
1	D	309	ALA	2.5
1	D	326	ARG	2.5
1	D	228	GLY	2.5
1	B	301	ALA	2.5
1	D	166	SER	2.5
1	D	307	SER	2.5
1	B	345	ASP	2.5
1	D	123	LEU	2.4
1	C	71	ASN	2.4
1	D	260	LYS	2.4
1	D	301	ALA	2.4
1	A	241	SER	2.4
1	D	149	ILE	2.4
1	D	47	SER	2.4
1	D	173	GLY	2.4
1	D	209	ILE	2.3
1	D	218	ASP	2.3
1	D	237	ASN	2.3
1	D	264	PHE	2.3
1	D	216	ASP	2.3
1	D	211	ALA	2.3
1	C	205	LYS	2.3
1	D	117	ASP	2.2
1	D	192	LYS	2.2
1	D	127	ARG	2.2
1	D	152	VAL	2.2
1	D	97	PHE	2.2
1	A	239	ILE	2.2
1	C	109	LEU	2.2
1	C	41	GLY	2.2
1	C	298	ALA	2.2
1	D	279	LYS	2.2
1	C	311	LYS	2.1
1	C	167	ASP	2.1

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Mol	Chain	Res	Type	RSRZ
1	D	196	ASP	2.1
1	D	154	SER	2.1
1	C	258	ASP	2.1
1	D	50	ILE	2.1
1	D	203	LYS	2.1
1	D	118	ALA	2.1
1	D	89	ALA	2.0
1	D	60	PRO	2.0
1	D	165	VAL	2.0
1	D	328	ILE	2.0
1	D	339	PRO	2.0
1	C	325	GLU	2.0
1	D	224	GLN	2.0
1	B	110	VAL	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

## 6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 6.4 Ligands ⓘ

There are no ligands in this entry.

## 6.5 Other polymers ⓘ

There are no such residues in this entry.