



# Full wwPDB X-ray Structure Validation Report ⓘ

May 17, 2020 – 04:19 pm BST

PDB ID : 2OPI  
Title : Crystal Structure of L-fuculose-1-phosphate aldolase from Bacteroides thetaio-  
taomicron  
Authors : Chang, C.; Volkart, L.; Abdullah, J.; Joachimiak, A.; Midwest Center for  
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Deposited on : 2007-01-29  
Resolution : 2.50 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.

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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	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.11
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)	:	2.11

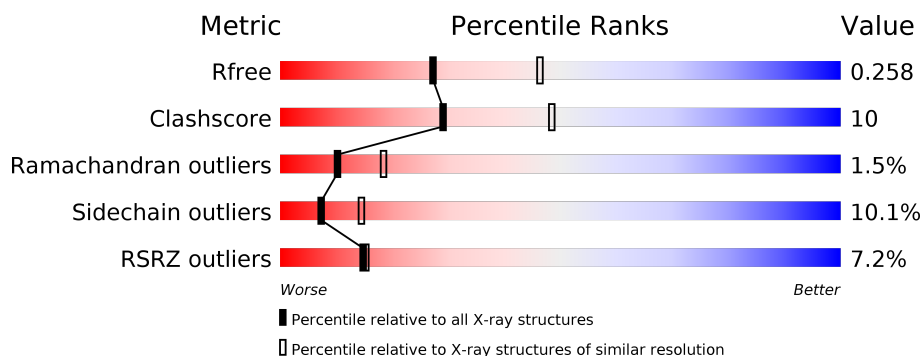
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.50 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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)

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 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	212	<div> <div>2%</div> <div> <div></div> <div>73%</div> <div>19%</div> <div>• •</div> </div> </div>
1	B	212	<div> <div>12%</div> <div> <div></div> <div>72%</div> <div>24%</div> <div>• •</div> </div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3228 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 L-fuculose-1-phosphate aldolase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	203	Total	C	N	O	S	Se	0	0	0
			1565	989	263	301	6	6			
1	B	209	Total	C	N	O	S	Se	0	0	0
			1613	1023	270	308	6	6			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
A	23	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
A	73	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
A	105	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
A	147	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
A	179	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
B	1	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
B	23	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
B	73	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
B	105	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
B	147	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12
B	179	MSE	MET	MODIFIED RESIDUE	UNP Q9RQ12

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	B	1	Total	O	S	0	0
			5	4	1		

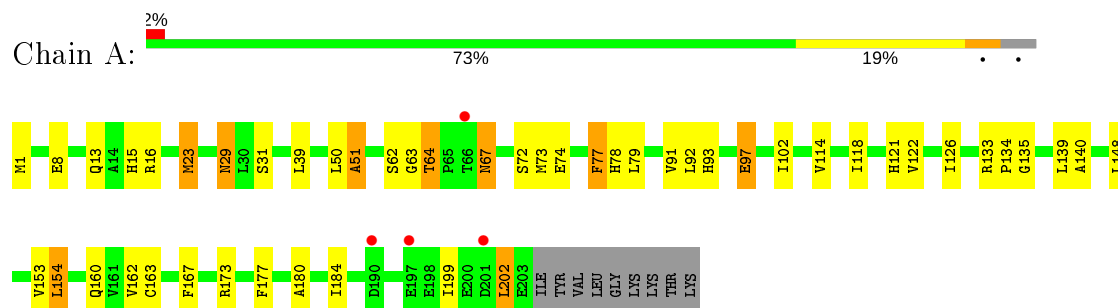
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	18	Total	O	0	0
			18	18		
3	B	22	Total	O	0	0
			22	22		

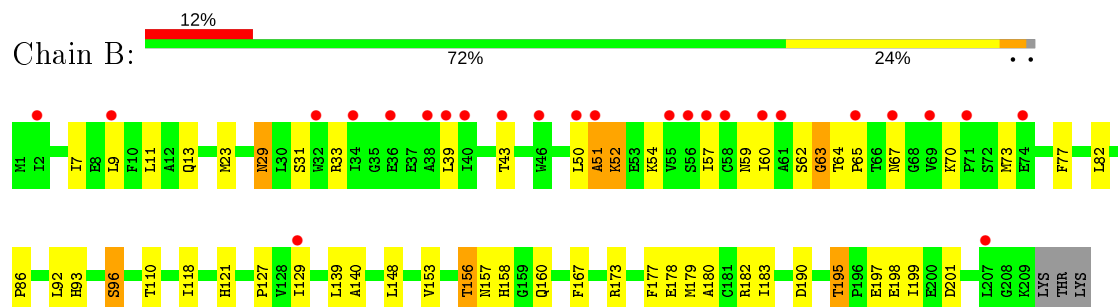
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of 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: L-fuculose-1-phosphate aldolase



- Molecule 1: L-fuculose-1-phosphate aldolase



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	115.93 Å 115.93 Å 73.72 Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	45.55 – 2.50 45.57 – 2.50	Depositor EDS
% Data completeness (in resolution range)	96.9 (45.55-2.50) 96.9 (45.57-2.50)	Depositor EDS
$R_{merge}$	0.14	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.00 (at 2.51 Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.225 , 0.260 0.221 , 0.258	Depositor DCC
$R_{free}$ test set	1002 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	59.3	Xtriage
Anisotropy	0.071	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 44.2	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.050 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	3228	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	62.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.94% 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: SO4

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	0.52	1/1594 (0.1%)	0.66	0/2157
1	B	0.47	0/1643	0.61	0/2223
All	All	0.49	1/3237 (0.0%)	0.63	0/4380

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	B	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	163	CYS	CB-SG	-6.47	1.71	1.82

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	50	LEU	Peptide

### 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	1565	0	1544	34	0
1	B	1613	0	1600	28	0
2	A	5	0	0	0	0
2	B	5	0	0	0	0
3	A	18	0	0	1	0
3	B	22	0	0	1	0
All	All	3228	0	3144	61	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 10.

All (61) 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:50:LEU:HA	1:A:51:ALA:CB	1.96	0.94
1:B:129:ILE:O	1:B:156:THR:HG23	1.70	0.91
1:B:51:ALA:HB1	1:B:54:LYS:H	1.42	0.85
1:A:50:LEU:HA	1:A:51:ALA:HB2	1.56	0.85
1:B:195:THR:HG22	1:B:198:GLU:H	1.41	0.85
1:A:121:HIS:O	1:A:173:ARG:HD3	1.77	0.84
1:A:15:HIS:NE2	1:A:50:LEU:O	2.14	0.79
1:A:29:ASN:ND2	1:A:78:HIS:HE1	1.82	0.78
1:B:121:HIS:O	1:B:173:ARG:HD2	1.87	0.74
1:A:73:MSE:O	1:A:74:GLU:HB2	1.88	0.72
1:A:13:GLN:HG2	1:A:167:PHE:CG	2.23	0.72
1:B:96:SER:HB3	1:B:178:GLU:OE1	1.91	0.70
1:A:133:ARG:NH1	1:A:134:PRO:O	2.24	0.70
1:A:23:MSE:HE3	1:A:92:LEU:HD11	1.77	0.67
1:A:50:LEU:HA	1:A:51:ALA:HB3	1.76	0.66
1:B:127:PRO:O	1:B:153:VAL:HG23	1.96	0.65
1:A:13:GLN:HG2	1:A:167:PHE:CD2	2.32	0.64
1:B:43:THR:HG21	1:B:70:LYS:HE3	1.79	0.63
1:A:50:LEU:CA	1:A:51:ALA:CB	2.75	0.63
1:A:29:ASN:HD22	1:A:78:HIS:HE1	1.44	0.62
1:A:29:ASN:HD22	1:A:78:HIS:CE1	2.20	0.59
1:B:59:ASN:O	1:B:63:GLY:HA2	2.03	0.58
3:A:316:HOH:O	1:B:179:MSE:HE1	2.04	0.57
1:A:29:ASN:ND2	1:A:93:HIS:HB3	2.19	0.57
1:B:77:PHE:HB3	1:B:140:ALA:HA	1.84	0.57
1:A:97:GLU:HG3	1:B:182:ARG:HD3	1.86	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:23:MSE:HE1	1:B:92:LEU:HD11	1.88	0.56
1:A:133:ARG:HG2	1:A:133:ARG:HH11	1.71	0.55
1:A:121:HIS:O	1:A:173:ARG:CD	2.53	0.52
1:B:179:MSE:O	1:B:183:ILE:HG12	2.10	0.52
1:B:31:SER:HA	1:B:39:LEU:O	2.09	0.51
1:B:13:GLN:HG3	1:B:167:PHE:CG	2.45	0.51
1:A:29:ASN:ND2	1:A:78:HIS:CE1	2.72	0.50
1:A:67:ASN:H	1:A:67:ASN:HD22	1.60	0.50
1:B:62:SER:O	1:B:64:THR:N	2.43	0.50
1:B:118:ILE:HD12	1:B:180:ALA:HB2	1.94	0.48
1:B:33:ARG:NH2	1:B:82:LEU:O	2.46	0.48
1:B:29:ASN:ND2	1:B:93:HIS:HB3	2.28	0.48
1:B:129:ILE:O	1:B:156:THR:CG2	2.54	0.48
1:A:180:ALA:O	1:A:184:ILE:HG12	2.16	0.45
1:A:133:ARG:HG2	1:A:133:ARG:NH1	2.32	0.45
1:A:118:ILE:HD12	1:A:180:ALA:HB2	1.98	0.45
1:A:72:SER:OG	1:A:73:MSE:O	2.24	0.44
1:A:74:GLU:HG3	1:A:135:GLY:HA2	2.00	0.44
1:B:51:ALA:O	1:B:52:LYS:HB3	2.18	0.43
1:B:57:ILE:O	1:B:65:PRO:HA	2.18	0.43
1:A:63:GLY:HA2	1:A:79:LEU:HD13	1.99	0.43
1:B:33:ARG:HH12	1:B:86:PRO:HA	1.84	0.43
1:B:51:ALA:HB2	1:B:54:LYS:HB2	2.00	0.43
1:A:77:PHE:HB3	1:A:140:ALA:HA	2.01	0.43
1:B:51:ALA:HB1	1:B:54:LYS:N	2.23	0.43
1:A:31:SER:OG	1:A:78:HIS:HD2	2.02	0.42
1:A:50:LEU:CA	1:A:51:ALA:HB3	2.45	0.42
1:A:31:SER:HA	1:A:39:LEU:O	2.19	0.42
1:A:102:ILE:HG22	1:A:154:LEU:HD11	2.00	0.41
1:A:78:HIS:HD2	1:A:91:VAL:HB	1.85	0.41
1:B:157:ASN:ND2	3:B:311:HOH:O	2.53	0.41
1:B:51:ALA:O	1:B:52:LYS:CB	2.69	0.41
1:B:7:ILE:O	1:B:11:LEU:HG	2.20	0.40
1:A:62:SER:OG	1:A:64:THR:HG23	2.22	0.40
1:A:122:VAL:HG12	1:A:126:ILE:HD11	2.03	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	A	201/212 (95%)	190 (94%)	8 (4%)	3 (2%)	10	18
1	B	207/212 (98%)	197 (95%)	7 (3%)	3 (1%)	11	20
All	All	408/424 (96%)	387 (95%)	15 (4%)	6 (2%)	10	18

All (6) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	51	ALA
1	B	52	LYS
1	A	97	GLU
1	B	63	GLY
1	A	202	LEU
1	B	51	ALA

### 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	A	175/177 (99%)	157 (90%)	18 (10%)	7	14
1	B	180/177 (102%)	162 (90%)	18 (10%)	7	15
All	All	355/354 (100%)	319 (90%)	36 (10%)	7	14

All (36) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MSE
1	A	8	GLU
1	A	16	ARG
1	A	23	MSE
1	A	29	ASN
1	A	64	THR
1	A	67	ASN
1	A	77	PHE
1	A	114	VAL
1	A	139	LEU
1	A	148	LEU
1	A	153	VAL
1	A	154	LEU
1	A	160	GLN
1	A	162	VAL
1	A	177	PHE
1	A	199	ILE
1	A	202	LEU
1	B	9	LEU
1	B	29	ASN
1	B	60	ILE
1	B	67	ASN
1	B	73	MSE
1	B	96	SER
1	B	110	THR
1	B	139	LEU
1	B	148	LEU
1	B	156	THR
1	B	158	HIS
1	B	160	GLN
1	B	177	PHE
1	B	190	ASP
1	B	195	THR
1	B	197	GLU
1	B	199	ILE
1	B	201	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	29	ASN
1	A	67	ASN
1	A	78	HIS

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Mol	Chain	Res	Type
1	A	93	HIS
1	A	158	HIS
1	B	29	ASN
1	B	67	ASN
1	B	93	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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

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	SO4	B	302	-	4,4,4	0.15	0	6,6,6	0.16	0
2	SO4	A	301	-	4,4,4	0.15	0	6,6,6	0.28	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

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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	197/212 (92%)	0.23	4 (2%) 65 68	53, 59, 68, 82	0
1	B	203/212 (95%)	0.69	25 (12%) 4 3	49, 64, 83, 89	0
All	All	400/424 (94%)	0.46	29 (7%) 15 15	49, 60, 77, 89	0

All (29) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	51	ALA	6.0
1	B	69	VAL	4.4
1	B	58	CYS	3.4
1	B	57	ILE	3.3
1	A	197	GLU	3.1
1	B	60	ILE	3.1
1	B	2	ILE	3.0
1	B	38	ALA	2.9
1	B	61	ALA	2.8
1	B	50	LEU	2.7
1	B	36	GLU	2.7
1	B	129	ILE	2.5
1	B	32	TRP	2.4
1	A	190	ASP	2.4
1	B	71	PRO	2.4
1	B	56	SER	2.4
1	B	55	VAL	2.3
1	B	43	THR	2.3
1	B	74	GLU	2.3
1	B	207	LEU	2.3
1	A	201	ASP	2.2
1	B	39	LEU	2.2
1	A	66	THR	2.2
1	B	40	ILE	2.2

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Mol	Chain	Res	Type	RSRZ
1	B	46	TRP	2.1
1	B	9	LEU	2.1
1	B	67	ASN	2.1
1	B	65	PRO	2.0
1	B	34	ILE	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 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. 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	SO4	B	302	5/5	0.97	0.22	85,85,85,85	0
2	SO4	A	301	5/5	0.99	0.09	55,55,55,57	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.