



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 09:04 AM UTC

PDB ID : 4U0H / pdb_00004u0h
Title : Crystal Structure of M. tuberculosis ClpP1P1
Authors : Schmitz, K.R.; Carney, D.W.; Sello, J.K.; Sauer, R.T.
Deposited on : 2014-07-11
Resolution : 3.25 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

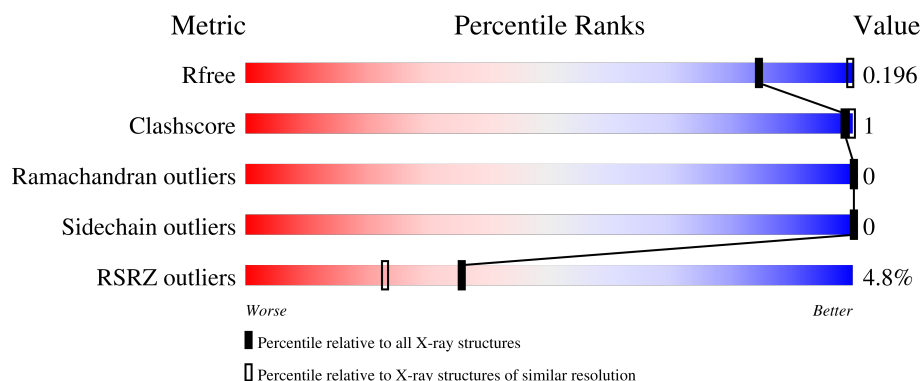
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.25 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	2153 (3.28-3.20)
Clashscore	190562	2275 (3.28-3.20)
Ramachandran outliers	187476	2233 (3.28-3.20)
Sidechain outliers	187428	2232 (3.28-3.20)
RSRZ outliers	180081	2153 (3.28-3.20)

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	194	5% 90% 8%
1	B	194	4% 90% 10%
1	C	194	5% 91% 9%
1	D	194	3% 91% 9%
1	E	194	4% 90% 8%

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Mol	Chain	Length	Quality of chain
1	F	194	6% 88% 10%
1	G	194	4% 87% 10%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 18884 atoms, of which 9354 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.

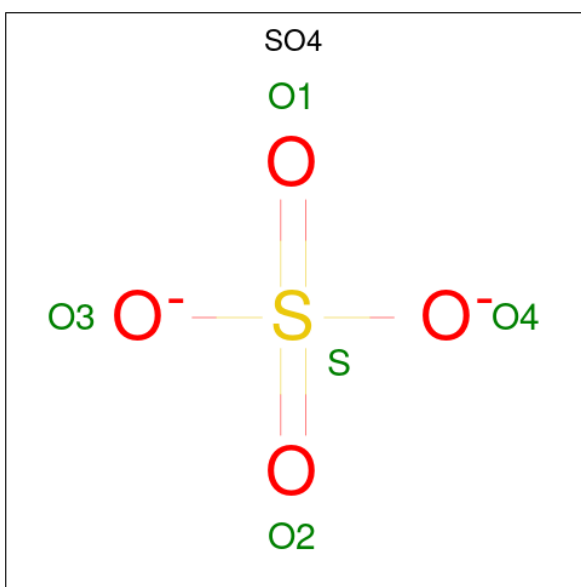
- Molecule 1 is a protein called ATP-dependent Clp protease proteolytic subunit 1.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
1	A	178	Total	C	H	N	O	S	Se	0	0	0
			2704	858	1348	229	260	2	7			
1	B	175	Total	C	H	N	O	S	Se	0	0	0
			2686	854	1339	228	256	2	7			
1	C	176	Total	C	H	N	O	S	Se	0	0	0
			2669	850	1329	224	257	2	7			
1	D	177	Total	C	H	N	O	S	Se	0	0	0
			2709	861	1351	230	258	2	7			
1	E	178	Total	C	H	N	O	S	Se	0	0	0
			2696	859	1342	226	260	2	7			
1	F	174	Total	C	H	N	O	S	Se	0	0	0
			2667	849	1327	227	255	2	7			
1	G	174	Total	C	H	N	O	S	Se	0	0	0
			2649	845	1318	222	255	2	7			

There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	7	MSE	-	initiating methionine	UNP P9WPC5
B	7	MSE	-	initiating methionine	UNP P9WPC5
C	7	MSE	-	initiating methionine	UNP P9WPC5
D	7	MSE	-	initiating methionine	UNP P9WPC5
E	7	MSE	-	initiating methionine	UNP P9WPC5
F	7	MSE	-	initiating methionine	UNP P9WPC5
G	7	MSE	-	initiating methionine	UNP P9WPC5

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	A	1	Total	O	S	0	0
			5	4	1		
2	C	1	Total	O	S	0	0
			5	4	1		
2	C	1	Total	O	S	0	0
			5	4	1		
2	D	1	Total	O	S	0	0
			5	4	1		
2	D	1	Total	O	S	0	0
			5	4	1		
2	D	1	Total	O	S	0	0
			5	4	1		
2	E	1	Total	O	S	0	0
			5	4	1		
2	E	1	Total	O	S	0	0
			5	4	1		
2	E	1	Total	O	S	0	0
			5	4	1		
2	G	1	Total	O	S	0	0
			5	4	1		
2	G	1	Total	O	S	0	0
			5	4	1		
2	G	1	Total	O	S	0	0
			5	4	1		

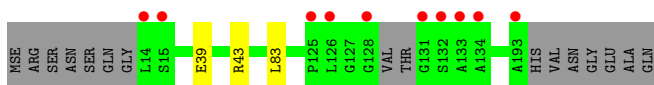
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	4	Total O 4 4	0	0
3	B	4	Total O 4 4	0	0
3	C	10	Total O 10 10	0	0
3	D	6	Total O 6 6	0	0
3	E	4	Total O 4 4	0	0
3	F	3	Total O 3 3	0	0
3	G	3	Total O 3 3	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.

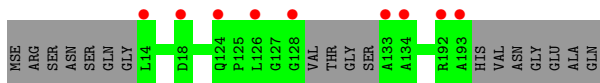
- Molecule 1: ATP-dependent Clp protease proteolytic subunit 1



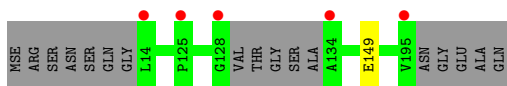
- Molecule 1: ATP-dependent Clp protease proteolytic subunit 1



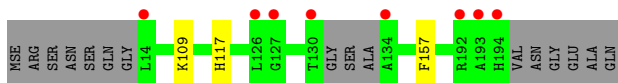
- Molecule 1: ATP-dependent Clp protease proteolytic subunit 1



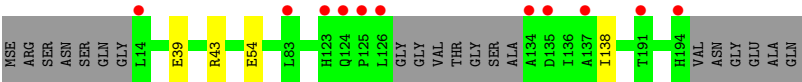
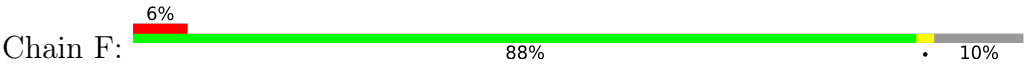
- Molecule 1: ATP-dependent Clp protease proteolytic subunit 1



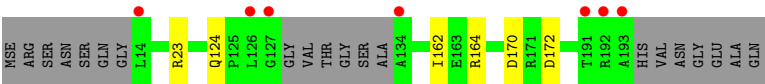
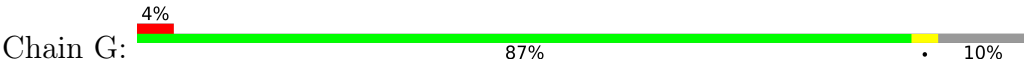
- Molecule 1: ATP-dependent Clp protease proteolytic subunit 1



- Molecule 1: ATP-dependent Clp protease proteolytic subunit 1



● Molecule 1: ATP-dependent Clp protease proteolytic subunit 1



4 Data and refinement statistics

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, α , β , γ	178.93Å 178.93Å 265.25Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.99 – 3.25 30.99 – 3.25	Depositor EDS
% Data completeness (in resolution range)	98.9 (30.99-3.25) 98.9 (30.99-3.25)	Depositor EDS
R_{merge}	0.19	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$	-	Xtrriage
Refinement program	PHENIX (phenix.refine: dev_1760)	Depositor
R, R_{free}	0.180 , 0.214 0.188 , 0.196	Depositor DCC
R_{free} test set	1988 reflections (4.94%)	wwPDB-VP
Wilson B-factor (Å ²)	(Not available)	Xtrriage
Anisotropy	(Not available)	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 23.9	EDS
L-test for twinning ¹	$\langle L \rangle =$ (Not available), $\langle L^2 \rangle =$ (Not available)	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	18884	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *(Not available)*

¹Theoretical 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	0.33	0/1370	0.63	0/1838
1	B	0.33	0/1362	0.66	0/1828
1	C	0.34	0/1354	0.63	0/1818
1	D	0.34	0/1373	0.64	0/1843
1	E	0.34	0/1368	0.65	0/1838
1	F	0.32	0/1355	0.64	0/1819
1	G	0.31	0/1345	0.64	0/1806
All	All	0.33	0/9527	0.64	0/12790

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	1356	1348	1348	2	0
1	B	1347	1339	1339	1	0
1	C	1340	1329	1329	0	0
1	D	1358	1351	1351	1	0
1	E	1354	1342	1342	2	0
1	F	1340	1327	1327	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	G	1331	1318	1321	5	0
2	A	10	0	0	0	0
2	C	10	0	0	0	0
2	D	20	0	0	0	0
2	E	15	0	0	0	0
2	G	15	0	0	1	0
3	A	4	0	0	0	0
3	B	4	0	0	0	0
3	C	10	0	0	0	0
3	D	6	0	0	0	0
3	E	4	0	0	0	0
3	F	3	0	0	0	0
3	G	3	0	0	0	0
All	All	9530	9354	9357	10	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 1.

All (10) 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:39:GLU:OE2	1:A:43:ARG:NH2	2.29	0.66
1:G:164:ARG:NH2	2:G:303:SO4:O2	2.29	0.65
1:F:39:GLU:OE2	1:F:43:ARG:NH1	2.35	0.60
1:G:124:GLN:NE2	1:G:170:ASP:OD1	2.52	0.42
1:F:54:GLU:OE2	1:G:23:ARG:NH2	2.49	0.42
1:G:162:ILE:HD12	1:G:162:ILE:H	1.85	0.42
1:A:83:LEU:HG	1:B:194:HIS:HB2	2.03	0.41
1:D:149:GLU:HG2	1:E:117:HIS:CD2	2.55	0.41
1:E:109:LYS:NZ	1:E:157:PHE:O	2.53	0.40
1:F:138:ILE:HD11	1:G:172:ASP:HB2	2.02	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	174/194 (90%)	169 (97%)	5 (3%)	0	100	100
1	B	171/194 (88%)	167 (98%)	4 (2%)	0	100	100
1	C	172/194 (89%)	168 (98%)	4 (2%)	0	100	100
1	D	173/194 (89%)	170 (98%)	3 (2%)	0	100	100
1	E	174/194 (90%)	170 (98%)	4 (2%)	0	100	100
1	F	170/194 (88%)	166 (98%)	4 (2%)	0	100	100
1	G	170/194 (88%)	166 (98%)	4 (2%)	0	100	100
All	All	1204/1358 (89%)	1176 (98%)	28 (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	A	138/143 (96%)	138 (100%)	0	100	100
1	B	138/143 (96%)	138 (100%)	0	100	100
1	C	136/143 (95%)	136 (100%)	0	100	100
1	D	139/143 (97%)	139 (100%)	0	100	100
1	E	138/143 (96%)	138 (100%)	0	100	100
1	F	137/143 (96%)	137 (100%)	0	100	100
1	G	136/143 (95%)	136 (100%)	0	100	100
All	All	962/1001 (96%)	962 (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. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	139	GLN
1	B	194	HIS
1	C	139	GLN
1	D	142	GLN
1	F	139	GLN
1	F	194	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

14 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	D	303	-	4,4,4	0.24	0	6,6,6	0.06	0
2	SO4	D	302	-	4,4,4	0.23	0	6,6,6	0.07	0
2	SO4	C	301	-	4,4,4	0.24	0	6,6,6	0.09	0
2	SO4	D	304	-	4,4,4	0.24	0	6,6,6	0.08	0
2	SO4	C	302	-	4,4,4	0.24	0	6,6,6	0.08	0
2	SO4	G	301	-	4,4,4	0.24	0	6,6,6	0.08	0
2	SO4	E	301	-	4,4,4	0.25	0	6,6,6	0.08	0
2	SO4	A	302	-	4,4,4	0.24	0	6,6,6	0.06	0
2	SO4	G	303	-	4,4,4	0.23	0	6,6,6	0.06	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	SO4	A	301	-	4,4,4	0.25	0	6,6,6	0.07	0
2	SO4	E	303	-	4,4,4	0.23	0	6,6,6	0.08	0
2	SO4	E	302	-	4,4,4	0.23	0	6,6,6	0.08	0
2	SO4	G	302	-	4,4,4	0.23	0	6,6,6	0.08	0
2	SO4	D	301	-	4,4,4	0.24	0	6,6,6	0.07	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.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	G	303	SO4	1	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	171/194 (88%)	-0.23	10 (5%) 29 19	6, 21, 72, 107	0
1	B	168/194 (86%)	-0.20	7 (4%) 40 26	2, 20, 65, 96	0
1	C	169/194 (87%)	-0.24	9 (5%) 32 20	4, 17, 62, 94	0
1	D	170/194 (87%)	-0.36	5 (2%) 53 35	2, 16, 51, 72	0
1	E	171/194 (88%)	-0.17	8 (4%) 36 23	4, 21, 68, 98	0
1	F	167/194 (86%)	0.03	11 (6%) 24 16	4, 28, 70, 91	0
1	G	167/194 (86%)	-0.14	7 (4%) 40 26	9, 26, 60, 98	0
All	All	1183/1358 (87%)	-0.19	57 (4%) 35 23	2, 21, 68, 107	0

All (57) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	194	HIS	6.5
1	E	134	ALA	6.0
1	B	127	GLY	5.8
1	G	127	GLY	5.7
1	G	14	LEU	5.2
1	F	14	LEU	5.0
1	G	192	ARG	5.0
1	B	14	LEU	4.8
1	F	126	LEU	4.6
1	E	14	LEU	4.6
1	F	134	ALA	4.5
1	A	14	LEU	4.5
1	A	193	ALA	4.4
1	C	14	LEU	4.4
1	C	128	GLY	4.3
1	D	14	LEU	4.2
1	B	134	ALA	4.1

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Mol	Chain	Res	Type	RSRZ
1	F	123	HIS	3.9
1	A	126	LEU	3.7
1	F	124	GLN	3.7
1	C	134	ALA	3.6
1	E	127	GLY	3.6
1	A	133	ALA	3.5
1	E	192	ARG	3.4
1	D	128	GLY	3.4
1	G	134	ALA	3.4
1	F	125	PRO	3.4
1	E	130	THR	3.3
1	A	128	GLY	3.3
1	A	131	GLY	3.3
1	G	193	ALA	3.1
1	C	133	ALA	3.1
1	D	195	VAL	3.0
1	G	191	THR	3.0
1	G	126	LEU	2.9
1	E	193	ALA	2.8
1	B	125	PRO	2.7
1	B	194	HIS	2.7
1	C	192	ARG	2.6
1	F	135	ASP	2.6
1	D	125	PRO	2.5
1	A	134	ALA	2.5
1	C	126	LEU	2.5
1	B	193	ALA	2.4
1	F	194	HIS	2.4
1	A	15	SER	2.4
1	A	125	PRO	2.4
1	F	137	ALA	2.4
1	F	191	THR	2.4
1	D	134	ALA	2.3
1	B	15	SER	2.3
1	A	132	SER	2.2
1	E	126	LEU	2.1
1	C	193	ALA	2.1
1	C	124	GLN	2.1
1	F	83	LEU	2.1
1	C	18	ASP	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 oligosaccharides in this entry.

6.4 Ligands ⓘ

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	SO4	E	303	5/5	0.70	0.28	72,86,119,150	0
2	SO4	D	303	5/5	0.71	0.28	55,65,81,95	0
2	SO4	C	302	5/5	0.72	0.23	67,94,116,127	0
2	SO4	A	302	5/5	0.75	0.24	79,85,101,110	0
2	SO4	D	302	5/5	0.75	0.17	55,66,101,102	0
2	SO4	E	302	5/5	0.76	0.23	85,88,96,106	0
2	SO4	G	302	5/5	0.76	0.25	71,77,91,109	0
2	SO4	G	303	5/5	0.81	0.18	85,87,109,128	0
2	SO4	D	304	5/5	0.85	0.16	62,63,67,94	0
2	SO4	E	301	5/5	0.88	0.16	55,57,67,81	0
2	SO4	A	301	5/5	0.90	0.11	33,52,72,81	0
2	SO4	C	301	5/5	0.91	0.12	41,51,65,83	0
2	SO4	D	301	5/5	0.91	0.14	46,47,64,71	0
2	SO4	G	301	5/5	0.92	0.14	32,44,60,66	0

6.5 Other polymers ⓘ

There are no such residues in this entry.