WORLDWIDE wwPDB PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report ⓘ

Jul 13, 2022 – 10:10 am BST

PDB ID	:	7OW4
Title	:	Crystal structure of HLA-A*11:01 in complex with KRAS G12D peptide (VVVGADGVGK)
Authors	:	Coles, C.H.; Karuppiah, V.; Robinson, R.A.
Deposited on	:	2021-06-16
Resolution	:	1.81 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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.
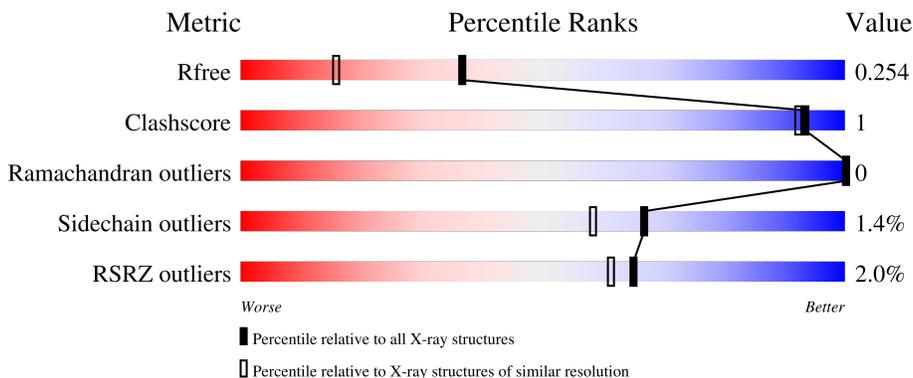
1   Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.81 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	Percentile Ranks	Value
Rfree		0.254
Clashscore		1
Ramachandran outliers		0
Sidechain outliers		1.4%
RSRZ outliers		2.0%

Worse ... *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R$_{free}$	130704	7484 (1.84-1.80)
Clashscore	141614	8401 (1.84-1.80)
Ramachandran outliers	138981	8290 (1.84-1.80)
Sidechain outliers	138945	8290 (1.84-1.80)
RSRZ outliers	127900	7371 (1.84-1.80)

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 <=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	276	% 95% 5%
1	D	276	2% 96% •
1	G	276	2% 95% 5% •
1	J	276	2% 96% • •
2	B	100	% 95% 5%

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Mol	Chain	Length	Quality of chain
2	E	100	2% 90% 10%
2	H	100	94% 6%
2	K	100	% 94% 5%
3	C	10	10% 80% 20%
3	F	10	10% 80% 20%
3	I	10	30% 80% 20%
3	L	10	10% 80% 20%

2 Entry composition ⓘ

There are 5 unique types of molecules in this entry. The entry contains 13589 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 MHC class I antigen.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	276	Total	C	N	O	S	0	1	0
			2258	1403	410	436	9			
1	D	276	Total	C	N	O	S	0	1	0
			2261	1404	410	438	9			
1	G	274	Total	C	N	O	S	0	0	0
			2235	1389	407	430	9			
1	J	274	Total	C	N	O	S	0	0	0
			2235	1389	407	430	9			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	276	PRO	-	expression tag	UNP A0A583ZB34
D	276	PRO	-	expression tag	UNP A0A583ZB34
G	276	PRO	-	expression tag	UNP A0A583ZB34
J	276	PRO	-	expression tag	UNP A0A583ZB34

- Molecule 2 is a protein called Beta-2-microglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	100	Total	C	N	O	S	0	0	0
			837	533	141	159	4			
2	E	100	Total	C	N	O	S	0	2	0
			848	542	143	159	4			
2	H	100	Total	C	N	O	S	0	0	0
			837	533	141	159	4			
2	K	100	Total	C	N	O	S	0	1	0
			844	538	143	159	4			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	0	MET	-	initiating methionine	UNP P61769
E	0	MET	-	initiating methionine	UNP P61769
H	0	MET	-	initiating methionine	UNP P61769
K	0	MET	-	initiating methionine	UNP P61769

- Molecule 3 is a protein called KRAS G12D peptide (VVVGADGVGK).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	8	Total 50	C 32	N 9	O 9	0	0	0
3	F	8	Total 50	C 32	N 9	O 9	0	0	0
3	I	8	Total 50	C 32	N 9	O 9	0	0	0
3	L	8	Total 50	C 32	N 9	O 9	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	6	ASP	GLY	engineered mutation	UNP P01111
F	6	ASP	GLY	engineered mutation	UNP P01111
I	6	ASP	GLY	engineered mutation	UNP P01111
L	6	ASP	GLY	engineered mutation	UNP P01111

- Molecule 4 is SULFATE ION (three-letter code: SO4) (formula: O_4S).
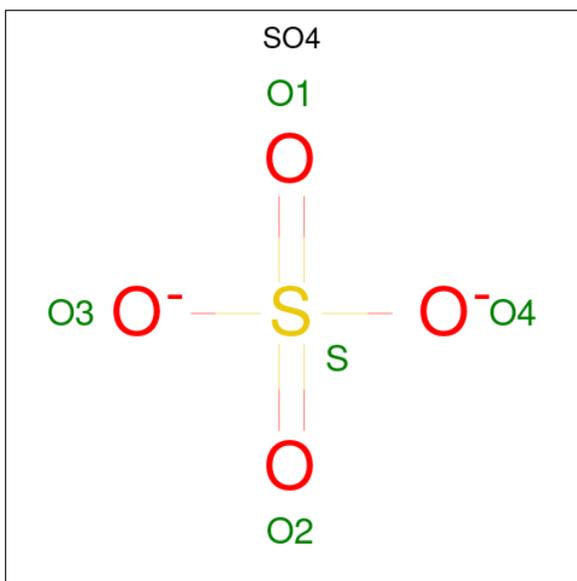
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	D	1	Total 5	O 4	S 1	0	0
4	G	1	Total 5	O 4	S 1	0	0
4	H	1	Total 5	O 4	S 1	0	0
4	J	1	Total 5	O 4	S 1	0	0
4	K	1	Total 5	O 4	S 1	0	0

• Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	145	Total 145	O 145	0	0
5	B	95	Total 95	O 95	0	0
5	C	3	Total 3	O 3	0	0
5	D	169	Total 169	O 169	0	0
5	E	88	Total 88	O 88	0	0
5	F	3	Total 3	O 3	0	0
5	G	163	Total 163	O 163	0	0
5	H	87	Total 87	O 87	0	0
5	I	4	Total 4	O 4	0	0
5	J	162	Total 162	O 162	0	0
5	K	87	Total 87	O 87	0	0
5	L	3	Total 3	O 3	0	0

3 Residue-property plots ⓘ

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: MHC class I antigen

Chain A:

- Molecule 1: MHC class I antigen

Chain D:

- Molecule 1: MHC class I antigen
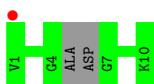
Chain G:

- Molecule 1: MHC class I antigen

Chain J:
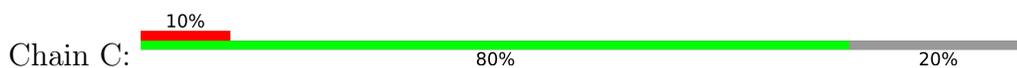
- Molecule 2: Beta-2-microglobulin
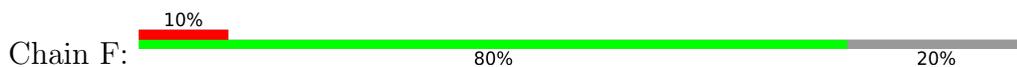
Chain B:

- Molecule 2: Beta-2-microglobulin

Chain E:

2%

90%   10%

M0 V27 G43 H51 W60 L65 F70 K75 N83 P90 D98 M99

• Molecule 2: Beta-2-microglobulin

Chain H:

94%   6%

M0 H51 W60 L65 F70 E74 E77 M99

• Molecule 2: Beta-2-microglobulin

Chain K:

%

94%   5%

M0 K48 H51 W60 L65 F70 N83 P90 M99

• Molecule 3: KRAS G12D peptide (VVVGADGVGK)

Chain C:

10%

80%   20%

V1 G4 ALA ASP G7 K10

• Molecule 3: KRAS G12D peptide (VVVGADGVGK)

Chain F:

10%

80%   20%

V1 G4 ALA ASP G7 K10

• Molecule 3: KRAS G12D peptide (VVVGADGVGK)

Chain I:

30%

80%   20%

V1 G4 ALA ASP G7 V8 G9 K10

• Molecule 3: KRAS G12D peptide (VVVGADGVGK)

Chain L:

10%

80%   20%

V1 G4 ALA ASP G7 K10
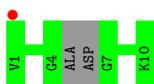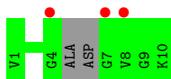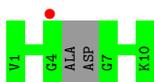
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	117.22Å 121.43Å 127.86Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	88.05 – 1.81 88.05 – 1.81	Depositor EDS
% Data completeness (in resolution range)	100.0 (88.05-1.81) 100.0 (88.05-1.81)	Depositor EDS
R_{merge}	0.26	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.52 (at 1.81Å)	Xtriage
Refinement program	REFMAC 5.8.0267	Depositor
R, R_{free}	0.220 , 0.249 0.225 , 0.254	Depositor DCC
R_{free} test set	8118 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å^2)	21.5	Xtriage
Anisotropy	0.321	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	(Not available) , (Not available)	EDS
L-test for twinning[2]	$< |L| > = 0.50, < L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.000 for k,h,-l	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	13589	wwPDB-VP
Average B, all atoms (Å^2)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 48.30 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 8.7708e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: 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	0.66	0/2323	0.84	0/3153
1	D	0.68	0/2323	0.85	0/3153
1	G	0.67	0/2296	0.83	0/3117
1	J	0.67	0/2296	0.82	0/3117
2	B	0.66	0/860	0.80	0/1162
2	E	0.65	0/878	0.80	0/1188
2	H	0.62	0/860	0.77	0/1162
2	K	0.65	0/871	0.81	0/1178
3	C	1.21	0/48	1.12	0/60
3	F	1.19	0/48	1.30	0/60
3	I	1.03	0/48	1.03	0/60
3	L	0.85	0/48	0.93	0/60
All	All	0.67	0/12899	0.83	0/17470

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 ⓘ

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	2258	0	2106	7	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	D	2261	0	2103	4	0
1	G	2235	0	2085	10	0
1	J	2235	0	2085	4	0
2	B	837	0	803	3	0
2	E	848	0	819	6	0
2	H	837	0	803	4	0
2	K	844	0	810	4	0
3	C	50	0	59	0	0
3	F	50	0	59	0	0
3	I	50	0	59	0	0
3	L	50	0	59	0	0
4	D	5	0	0	0	0
4	G	5	0	0	0	0
4	H	5	0	0	0	0
4	J	5	0	0	0	0
4	K	5	0	0	0	0
5	A	145	0	0	0	0
5	B	95	0	0	1	0
5	C	3	0	0	0	0
5	D	169	0	0	0	0
5	E	88	0	0	0	0
5	F	3	0	0	0	0
5	G	163	0	0	1	0
5	H	87	0	0	0	0
5	I	4	0	0	0	0
5	J	162	0	0	0	0
5	K	87	0	0	0	0
5	L	3	0	0	0	0
All	All	13589	0	11850	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 1.

The worst 5 of 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)
2:K:83:ASN:ND2	2:K:90:PRO:HG3	2.10	0.67
1:A:138:MET:CE	1:G:225:THR:HG21	2.29	0.62
1:A:9:TYR:CE2	1:A:70[A]:GLN:HG2	2.38	0.59
1:G:117:ALA:HB2	2:H:60:TRP:CE2	2.41	0.55
2:K:83:ASN:HD21	2:K:90:PRO:HG3	1.70	0.55

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	275/276 (100%)	274 (100%)	1 (0%)	0	100	100
1	D	275/276 (100%)	273 (99%)	2 (1%)	0	100	100
1	G	272/276 (99%)	271 (100%)	1 (0%)	0	100	100
1	J	272/276 (99%)	271 (100%)	1 (0%)	0	100	100
2	B	98/100 (98%)	98 (100%)	0	0	100	100
2	E	100/100 (100%)	99 (99%)	1 (1%)	0	100	100
2	H	98/100 (98%)	96 (98%)	2 (2%)	0	100	100
2	K	99/100 (99%)	98 (99%)	1 (1%)	0	100	100
3	C	4/10 (40%)	4 (100%)	0	0	100	100
3	F	4/10 (40%)	4 (100%)	0	0	100	100
3	I	4/10 (40%)	4 (100%)	0	0	100	100
3	L	4/10 (40%)	4 (100%)	0	0	100	100
All	All	1505/1544 (98%)	1496 (99%)	9 (1%)	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	234/233 (100%)	229 (98%)	5 (2%)	53	41
1	D	234/233 (100%)	231 (99%)	3 (1%)	69	61
1	G	231/233 (99%)	229 (99%)	2 (1%)	78	74
1	J	231/233 (99%)	229 (99%)	2 (1%)	78	74
2	B	95/95 (100%)	94 (99%)	1 (1%)	73	67
2	E	97/95 (102%)	94 (97%)	3 (3%)	40	25
2	H	95/95 (100%)	94 (99%)	1 (1%)	73	67
2	K	96/95 (101%)	94 (98%)	2 (2%)	53	41
3	C	5/6 (83%)	5 (100%)	0	100	100
3	F	5/6 (83%)	5 (100%)	0	100	100
3	I	5/6 (83%)	5 (100%)	0	100	100
3	L	5/6 (83%)	5 (100%)	0	100	100
All	All	1333/1336 (100%)	1314 (99%)	19 (1%)	67	58

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	H	70	PHE
2	K	70	PHE
2	K	83	ASN
1	J	155	GLN
1	D	268	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 17 such sidechains are listed below:

Mol	Chain	Res	Type
1	J	96	GLN
1	J	226	GLN
1	D	192	HIS
1	D	226	GLN
2	E	83	ASN

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 monosaccharides in this entry.

5.6 Ligand geometry ⓘ

5 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	$\#|Z| > 2$
4	SO4	G	301	-	4,4,4	0.38	0	6,6,6	0.06	0
4	SO4	J	301	-	4,4,4	0.37	0	6,6,6	0.06	0
4	SO4	D	301	-	4,4,4	0.37	0	6,6,6	0.05	0
4	SO4	H	101	-	4,4,4	0.40	0	6,6,6	0.07	0
4	SO4	K	101	-	4,4,4	0.35	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.

No monomer is involved in short contacts.

5.7 Other polymers ⓘ

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 (i)

6.1 Protein, DNA and RNA chains (i)

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	276/276 (100%)	0.03	3 (1%)	80	78	14, 30, 46, 52	0
1	D	276/276 (100%)	0.04	6 (2%)	62	58	13, 26, 44, 58	0
1	G	274/276 (99%)	0.02	6 (2%)	62	58	14, 26, 54, 67	0
1	J	274/276 (99%)	-0.00	5 (1%)	68	64	15, 26, 48, 63	0
2	B	100/100 (100%)	-0.10	1 (1%)	82	80	16, 25, 41, 43	0
2	E	100/100 (100%)	-0.05	2 (2%)	65	61	14, 24, 40, 45	0
2	H	100/100 (100%)	-0.18	0	100	100	15, 23, 38, 42	0
2	K	100/100 (100%)	-0.19	1 (1%)	82	80	14, 22, 33, 39	0
3	C	8/10 (80%)	0.98	1 (12%)	3	2	38, 42, 47, 49	0
3	F	8/10 (80%)	0.95	1 (12%)	3	2	38, 46, 52, 53	0
3	I	8/10 (80%)	0.95	3 (37%)	0	0	25, 30, 38, 41	0
3	L	8/10 (80%)	0.41	1 (12%)	3	2	27, 29, 36, 40	0
All	All	1532/1544 (99%)	-0.00	30 (1%)	65	61	13, 26, 46, 67	0

The worst 5 of 30 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	E	99	MET	3.9
3	C	1	VAL	3.6
1	D	17	ARG	3.3
1	D	276	PRO	3.2
1	J	225	THR	3.2

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 ⓘ

There are no monosaccharides 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(Å^2)	Q<0.9
4	SO4	D	301	5/5	0.90	0.16	80,80,87,89	0
4	SO4	K	101	5/5	0.92	0.22	62,63,63,67	0
4	SO4	H	101	5/5	0.93	0.14	60,61,63,68	0
4	SO4	J	301	5/5	0.95	0.12	54,55,59,59	0
4	SO4	G	301	5/5	0.95	0.14	56,57,63,67	0

6.5 Other polymers ⓘ

There are no such residues in this entry.

W O R L D W I D E

wwPDB

PROTEIN DATA BANK