



# Full wwPDB X-ray Structure Validation Report i

Nov 24, 2025 – 12:08 pm GMT

PDB ID : 9HI4 / pdb\_00009hi4  
Title : Structure of FI6-focused design\_03 scaffold in complex with FI6-Fab  
Authors : Cramer, J.T.; Krey, T.  
Deposited on : 2024-11-24  
Resolution : 2.00 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 i 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](#) i) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0  
Mogul : 1.8.4, CSD as541be (2020)  
Xtriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
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) : 2.46

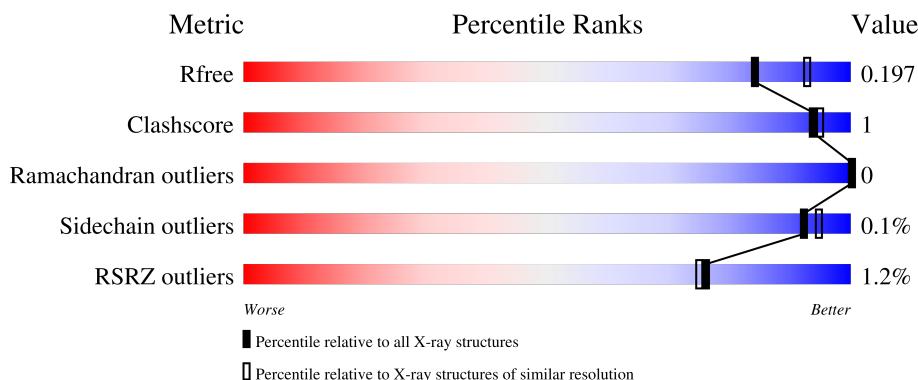
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 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))
$R_{free}$	164625	9409 (2.00-2.00)
Clashscore	180529	10737 (2.00-2.00)
Ramachandran outliers	177936	10628 (2.00-2.00)
Sidechain outliers	177891	10627 (2.00-2.00)
RSRZ outliers	164620	9409 (2.00-2.00)

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.



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Mol	Chain	Length	Quality of chain	
4	D	220	91%	6%

## 2 Entry composition (i)

There are 7 unique types of molecules in this entry. The entry contains 11503 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 FI6 Fab Heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	227	Total	C	N	O	S	0	3	0
			1747	1113	288	338	8			

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	K	228	Total	C	N	O	S	0	2	0
			1731	1104	287	333	7			

- Molecule 2 is a protein called FI6 Fab Light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	218	Total	C	N	O	S	0	7	0
			1724	1078	287	352	7			

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	218	Total	C	N	O	S	0	4	0
			1692	1061	282	342	7			

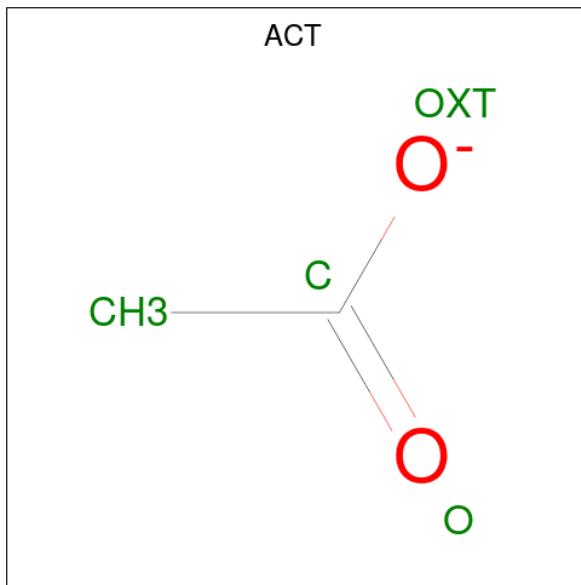
- Molecule 3 is a protein called FI6-focused design\_03.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	208	Total	C	N	O	P	S	0	2
			1617	1022	280	310	1	4		

- Molecule 4 is a protein called FI6-focused design\_03.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	207	Total	C	N	O	S	0	1	0
			1601	1014	278	305	4			

- Molecule 5 is ACETATE ION (CCD ID: ACT) (formula: C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>).



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

- Molecule 6 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	D	1	Total Na 1 1	0	0
6	L	1	Total Na 1 1	0	0

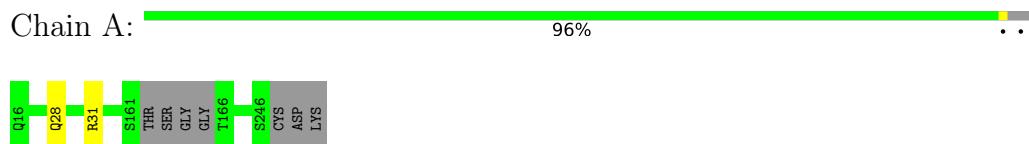
- Molecule 7 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	A	245	Total O 245 245	0	0
7	B	256	Total O 256 256	0	0
7	C	205	Total O 205 205	0	0
7	D	170	Total O 170 170	0	0
7	K	271	Total O 271 271	0	0
7	L	238	Total O 238 238	0	0

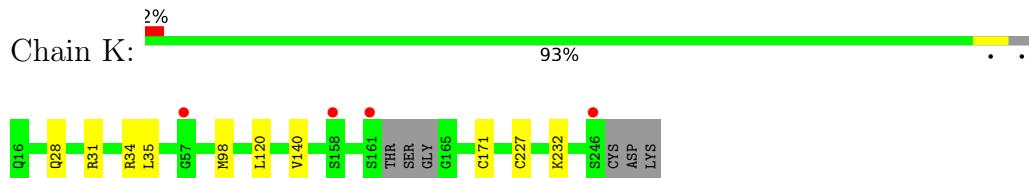
### 3 Residue-property plots [i](#)

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.

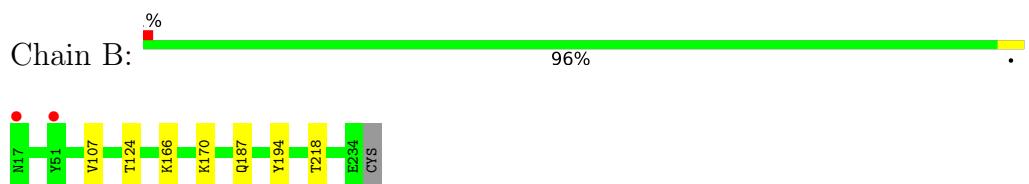
- Molecule 1: FI6 Fab Heavy chain



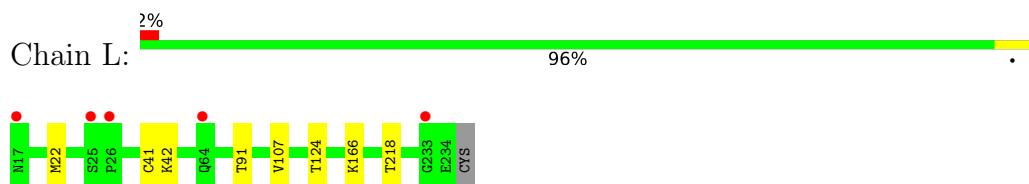
- Molecule 1: FI6 Fab Heavy chain



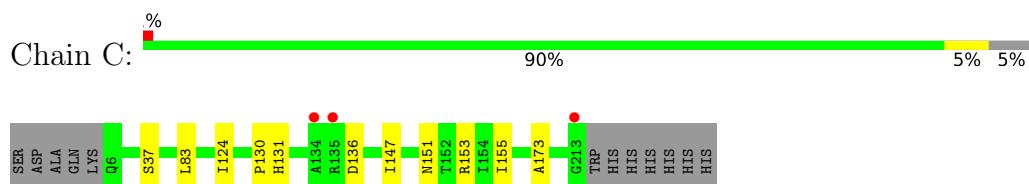
- Molecule 2: FI6 Fab Light chain



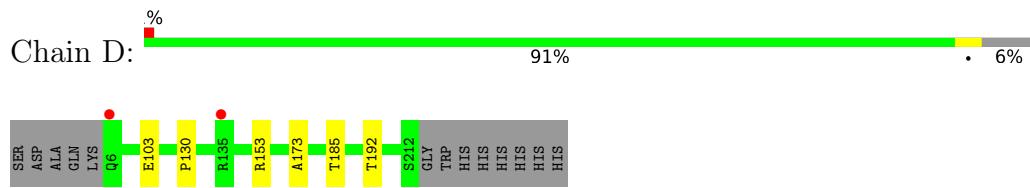
- Molecule 2: FI6 Fab Light chain



- Molecule 3: FI6-focused design 03



- Molecule 4: FI6-focused design 03



## 4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	91.23Å 78.14Å 118.72Å 90.00° 100.60° 90.00°	Depositor
Resolution (Å)	44.84 – 2.00 44.84 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.9 (44.84-2.00) 99.9 (44.84-2.00)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle^1$	5.28 (at 2.00Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487, PHENIX 1.20.1_4487	Depositor
$R$ , $R_{free}$	0.170 , 0.196 0.170 , 0.197	Depositor DCC
$R_{free}$ test set	5544 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	28.3	Xtriage
Anisotropy	0.349	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 39.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	11503	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	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 29.26 % 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 1.5990e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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: ACT, SEP, NA

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	0.14	0/1797	0.38	0/2449
1	K	0.16	0/1781	0.38	0/2429
2	B	0.14	0/1772	0.38	0/2414
2	L	0.15	0/1737	0.39	0/2370
3	C	0.12	0/1639	0.32	0/2223
4	D	0.12	0/1633	0.31	0/2217
All	All	0.14	0/10359	0.36	0/14102

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	1747	0	1693	1	0
1	K	1731	0	1664	7	0
2	B	1724	0	1638	4	0
2	L	1692	0	1594	5	0
3	C	1617	0	1547	6	0
4	D	1601	0	1539	3	0
5	D	4	0	3	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	D	1	0	0	0	0
6	L	1	0	0	0	0
7	A	245	0	0	0	0
7	B	256	0	0	1	0
7	C	205	0	0	0	0
7	D	170	0	0	0	0
7	K	271	0	0	1	0
7	L	238	0	0	0	0
All	All	11503	0	9678	25	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 (25) 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:L:107:VAL:HG22	2:L:124:THR:HG22	1.75	0.68
1:A:28:GLN:HB2	1:A:31:ARG:HG3	1.80	0.62
3:C:151:ASN:O	3:C:155:ILE:HG13	2.05	0.57
3:C:136:ASP:N	3:C:136:ASP:OD1	2.41	0.54
2:B:107:VAL:HG22	2:B:124[B]:THR:HG22	1.89	0.53
3:C:131[A]:HIS:CE1	3:C:147:ILE:HD11	2.44	0.53
2:B:170:LYS:NZ	7:B:304:HOH:O	2.43	0.52
4:D:185:THR:HA	4:D:192:THR:HG23	1.93	0.49
1:K:98:MET:HE1	1:K:140:VAL:HG21	1.94	0.48
3:C:83:LEU:HD11	3:C:124:ILE:HG13	1.95	0.48
2:L:166:LYS:HB3	2:L:218:THR:HB	1.97	0.47
1:K:232:LYS:HB2	1:K:232:LYS:HE3	1.69	0.47
3:C:155:ILE:HD12	1:K:120:LEU:HD11	1.97	0.46
2:B:187:GLN:HG3	2:B:194:TYR:CZ	2.52	0.45
2:L:22:MET:HE3	2:L:41:CYS:SG	2.56	0.45
2:B:166:LYS:HB3	2:B:218:THR:HB	1.99	0.45
2:L:22:MET:HE3	2:L:22:MET:HB3	1.89	0.45
1:K:34[B]:ARG:NH2	7:K:306:HOH:O	2.49	0.45
4:D:130:PRO:HG3	4:D:173:ALA:HB2	1.98	0.44
3:C:130:PRO:HG3	3:C:173:ALA:HB2	1.99	0.44
1:K:171[B]:CYS:HB3	1:K:227:CYS:SG	2.59	0.42
4:D:103:GLU:OE1	4:D:153[B]:ARG:NH2	2.53	0.42
1:K:28:GLN:HB2	1:K:31:ARG:HG3	2.02	0.41
2:L:42:LYS:HA	2:L:91:THR:O	2.21	0.41
1:K:35:LEU:HG	1:K:98:MET:HE2	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	226/234 (97%)	225 (100%)	1 (0%)	0	100 100
1	K	226/234 (97%)	223 (99%)	3 (1%)	0	100 100
2	B	222/219 (101%)	218 (98%)	4 (2%)	0	100 100
2	L	220/219 (100%)	217 (99%)	3 (1%)	0	100 100
3	C	207/220 (94%)	200 (97%)	7 (3%)	0	100 100
4	D	206/220 (94%)	200 (97%)	6 (3%)	0	100 100
All	All	1307/1346 (97%)	1283 (98%)	24 (2%)	0	100 100

There are no Ramachandran outliers to report.

#### 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	194/199 (98%)	194 (100%)	0	100 100
1	K	188/199 (94%)	188 (100%)	0	100 100
2	B	197/194 (102%)	197 (100%)	0	100 100
2	L	188/194 (97%)	188 (100%)	0	100 100
3	C	162/184 (88%)	160 (99%)	2 (1%)	67 73
4	D	162/185 (88%)	162 (100%)	0	100 100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	1091/1155 (94%)	1089 (100%)	2 (0%)	92 94

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	153[A]	ARG
3	C	153[B]	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	54	GLN
2	B	50	ASN
2	B	60	GLN
2	B	64	GLN
2	B	168	GLN
3	C	27	GLN
3	C	177	ASN
4	D	45	ASN
4	D	174	GLN
4	D	177	ASN
1	K	128	GLN
2	L	24	GLN
2	L	40	ASN
2	L	122	GLN

### 5.3.3 RNA [\(i\)](#)

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains [\(i\)](#)

1 non-standard protein/DNA/RNA residue 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	$\# Z  > 2$
3	SEP	C	37	3	8,9,10	1.53	1 (12%)	8,12,14	1.45	2 (25%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	SEP	C	37	3	-	2/5/8/10	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	37	SEP	P-O1P	3.30	1.61	1.50

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	37	SEP	OG-CB-CA	2.83	110.90	108.14
3	C	37	SEP	P-OG-CB	-2.14	112.41	118.30

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	37	SEP	CB-OG-P-O3P
3	C	37	SEP	CA-CB-OG-P

There are no ring outliers.

No monomer is involved in short contacts.

## 5.5 Carbohydrates [\(i\)](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [\(i\)](#)

Of 3 ligands modelled in this entry, 2 are monoatomic - leaving 1 for Mogul analysis.

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	$\# Z  > 2$
5	ACT	D	301	-	3,3,3	1.30	0	3,3,3	1.34	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 (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, 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	227/234 (97%)	-0.38	0 <span style="background-color: blue;">100</span> <span style="background-color: blue;">100</span>	14, 28, 42, 54	3 (1%)
1	K	228/234 (97%)	-0.36	4 (1%) <span style="background-color: blue;">67</span> <span style="background-color: blue;">66</span>	16, 26, 41, 60	2 (0%)
2	B	218/219 (99%)	-0.30	2 (0%) <span style="background-color: blue;">81</span> <span style="background-color: blue;">80</span>	11, 27, 43, 54	7 (3%)
2	L	218/219 (99%)	-0.23	5 (2%) <span style="background-color: blue;">61</span> <span style="background-color: blue;">59</span>	13, 27, 41, 54	4 (1%)
3	C	207/220 (94%)	-0.38	3 (1%) <span style="background-color: blue;">73</span> <span style="background-color: blue;">72</span>	14, 28, 49, 59	2 (0%)
4	D	207/220 (94%)	-0.27	2 (0%) <span style="background-color: blue;">79</span> <span style="background-color: blue;">78</span>	16, 31, 51, 60	1 (0%)
All	All	1305/1346 (96%)	-0.32	16 (1%) <span style="background-color: blue;">76</span> <span style="background-color: blue;">75</span>	11, 28, 46, 60	19 (1%)

All (16) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	C	134	ALA	3.3
1	K	161	SER	3.3
4	D	6	GLN	3.2
1	K	158	SER	3.0
2	L	17	ASN	2.7
2	L	233	GLY	2.7
2	L	64[A]	GLN	2.7
1	K	57	GLY	2.7
1	K	246	SER	2.6
2	L	26	PRO	2.4
3	C	135	ARG	2.2
2	B	17[A]	ASN	2.2
2	L	25	SER	2.1
4	D	135	ARG	2.1
2	B	51	TYR	2.0
3	C	213	GLY	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains [\(i\)](#)

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(Å <sup>2</sup> )	Q<0.9
3	SEP	C	37	10/11	0.93	0.10	23,27,43,43	0

## 6.3 Carbohydrates [\(i\)](#)

There are no oligosaccharides 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(Å <sup>2</sup> )	Q<0.9
6	NA	L	301	1/1	0.93	0.10	31,31,31,31	0
5	ACT	D	301	4/4	0.94	0.15	38,42,46,55	0
6	NA	D	302	1/1	0.98	0.07	28,28,28,28	0

## 6.5 Other polymers [\(i\)](#)

There are no such residues in this entry.