



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 24, 2025 – 12:07 pm GMT

PDB ID : 9HI6 / pdb\_00009hi6  
Title : Structure of scaffold FI6-focused design\_04 in complex with FI6-Fab  
Authors : Cramer, J.T.; Krey, T.  
Deposited on : 2024-11-24  
Resolution : 1.50 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)

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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>.

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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 : 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

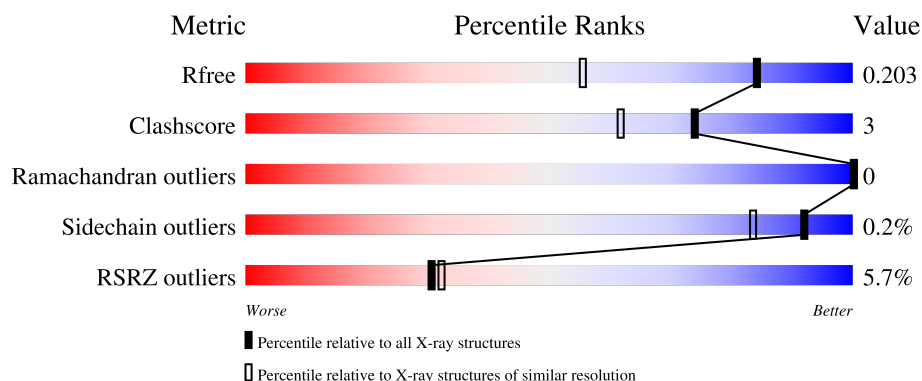
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.50 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))
$R_{free}$	164625	3717 (1.50-1.50)
Clashscore	180529	4048 (1.50-1.50)
Ramachandran outliers	177936	3970 (1.50-1.50)
Sidechain outliers	177891	3967 (1.50-1.50)
RSRZ outliers	164620	3718 (1.50-1.50)

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 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.

Mol	Chain	Length	Quality of chain
1	H	235	<div> <div>3%</div> <div>93%</div> <div>5%</div> </div>
2	L	217	<div> <div>11%</div> <div>88%</div> <div>9%</div> </div>
3	A	220	<div> <div>3%</div> <div>93%</div> <div>5%</div> </div>

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
4	CIT	A	302	-	X	-	-
5	PEG	A	303	-	-	X	-

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 5764 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	H	224	Total	C	N	O	S	0	3	0
			1701	1090	277	328	6			

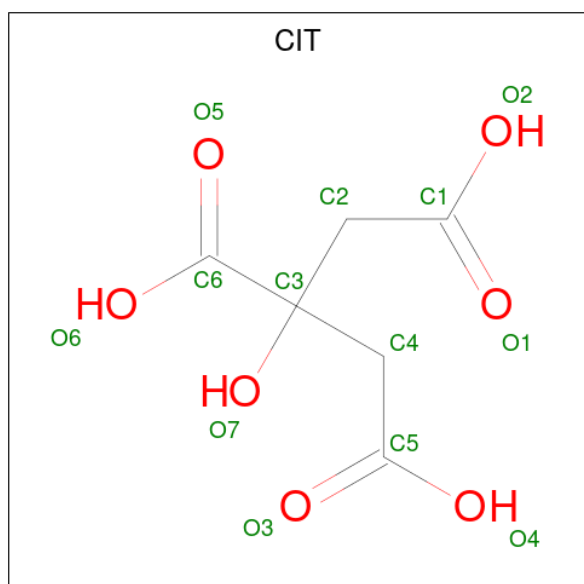
- Molecule 2 is a protein called FI6-Fab Light Chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	212	Total	C	N	O	S	0	2	0
			1619	1016	269	328	6			

- Molecule 3 is a protein called FI6-focused design\_04.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	A	215	Total	C	N	O	S	0	1	0
			1661	1050	291	313	7			

- Molecule 4 is CITRIC ACID (CCD ID: CIT) (formula: C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			13	6	7		
4	A	1	Total	C	O	0	0
			13	6	7		

- Molecule 5 is DI(HYDROXYETHYL)ETHER (CCD ID: PEG) (formula:  $C_4H_{10}O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			7	4	3		
5	A	1	Total	C	O	0	0
			7	4	3		

- Molecule 6 is water.

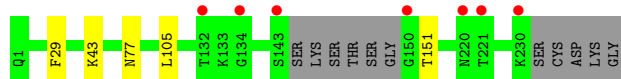
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	H	269	Total	O	0	0
			269	269		
6	L	171	Total	O	0	0
			171	171		
6	A	303	Total	O	0	0
			303	303		

### 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.

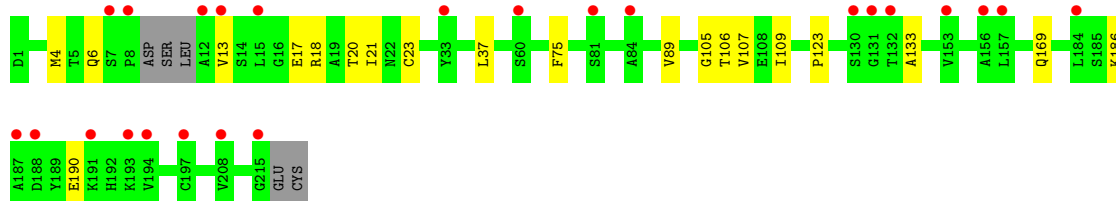
- Molecule 1: FI6 Fab Heavy Chain

Chain H: 



- Molecule 2: FI6-Fab Light Chain

Chain L: 



- Molecule 3: FI6-focused design\_04

Chain A: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	71.21Å 47.87Å 107.09Å 90.00° 106.13° 90.00°	Depositor
Resolution (Å)	43.40 – 1.50 43.40 – 1.50	Depositor EDS
% Data completeness (in resolution range)	99.5 (43.40-1.50) 99.5 (43.40-1.50)	Depositor EDS
$R_{merge}$	0.10	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.64 (at 1.50Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487, PHENIX 1.20.1_4487	Depositor
R, $R_{free}$	0.177 , 0.204 0.178 , 0.203	Depositor DCC
$R_{free}$ test set	5531 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	20.0	Xtriage
Anisotropy	0.193	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 41.7	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	0.97	EDS
Total number of atoms	5764	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.97% 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: CIT, PEG

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	H	0.39	0/1755	0.60	0/2399
2	L	0.32	0/1663	0.55	0/2272
3	A	0.40	0/1699	0.56	0/2305
All	All	0.37	0/5117	0.57	0/6976

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	H	1701	0	1626	4	0
2	L	1619	0	1505	14	0
3	A	1661	0	1604	11	0
4	A	26	0	10	1	0
5	A	14	0	20	5	0
6	A	303	0	0	4	0
6	H	269	0	0	2	0
6	L	171	0	0	0	0
All	All	5764	0	4765	29	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 3.

All (29) 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:109:ILE:H	2:L:169:GLN:HE22	1.30	0.76
3:A:56:TYR:HE1	5:A:303:PEG:H42	1.63	0.64
2:L:21:ILE:HD11	2:L:107:VAL:HG23	1.84	0.59
3:A:37:ASN:ND2	3:A:92:ASN:H	2.06	0.54
1:H:43:LYS:HE3	6:H:342:HOH:O	2.08	0.52
1:H:43:LYS:NZ	6:H:302:HOH:O	2.42	0.52
3:A:220:HIS:NE2	6:A:401:HOH:O	2.34	0.52
1:H:105:LEU:HD11	3:A:156:ILE:HD12	1.92	0.51
2:L:6:GLN:OE1	2:L:105:GLY:HA3	2.11	0.50
3:A:161:GLU:HG3	6:A:405:HOH:O	2.13	0.48
2:L:13:VAL:HG13	2:L:17:GLU:HB2	1.96	0.47
5:A:303:PEG:H31	6:A:453:HOH:O	2.15	0.47
2:L:18:ARG:HD3	2:L:20:THR:HG23	1.97	0.46
3:A:118:ARG:HG2	6:A:415:HOH:O	2.17	0.45
2:L:123:PRO:HG3	2:L:133:ALA:HB1	1.98	0.45
2:L:4:MET:HE3	2:L:23[A]:CYS:SG	2.58	0.44
3:A:212:LEU:HD12	5:A:303:PEG:H41	1.99	0.44
3:A:56:TYR:CE1	5:A:303:PEG:H42	2.50	0.43
2:L:186:LYS:O	2:L:190:GLU:HG2	2.19	0.42
2:L:6:GLN:HG2	2:L:23[B]:CYS:SG	2.59	0.42
2:L:6:GLN:CG	2:L:23[B]:CYS:SG	3.08	0.42
3:A:37:ASN:HB2	3:A:92:ASN:OD1	2.20	0.42
3:A:142:LYS:HD2	4:A:301:CIT:H21	2.02	0.41
2:L:37:LEU:HG	2:L:75:PHE:CG	2.55	0.41
2:L:89:VAL:HG22	2:L:106:THR:HG22	2.02	0.41
2:L:109:ILE:N	2:L:169:GLN:HE22	2.09	0.40
3:A:30:ASN:O	5:A:303:PEG:H21	2.21	0.40
2:L:13:VAL:CG1	2:L:17:GLU:HB2	2.51	0.40
1:H:29:PHE:CD2	1:H:77:ASN:HA	2.56	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	H	223/235 (95%)	219 (98%)	4 (2%)	0	100	100
2	L	210/217 (97%)	206 (98%)	4 (2%)	0	100	100
3	A	214/220 (97%)	211 (99%)	3 (1%)	0	100	100
All	All	647/672 (96%)	636 (98%)	11 (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	H	183/199 (92%)	182 (100%)	1 (0%)	86	75
2	L	178/192 (93%)	178 (100%)	0	100	100
3	A	171/184 (93%)	171 (100%)	0	100	100
All	All	532/575 (92%)	531 (100%)	1 (0%)	92	83

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	151	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	H	39	GLN
1	H	187	GLN
2	L	42	GLN
2	L	104	GLN
2	L	155	ASN

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Mol	Chain	Res	Type
2	L	163	GLN
2	L	169	GLN
3	A	30	ASN
3	A	105	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](#)

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](#)

4 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	$\# Z  > 2$
5	PEG	A	303	-	6,6,6	0.07	0	5,5,5	0.16	0
4	CIT	A	301	-	12,12,12	1.00	0	17,17,17	1.60	2 (11%)
5	PEG	A	304	-	6,6,6	0.07	0	5,5,5	0.14	0
4	CIT	A	302	-	12,12,12	1.14	1 (8%)	17,17,17	1.77	4 (23%)

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
5	PEG	A	303	-	-	3/4/4/4	-
4	CIT	A	301	-	-	8/16/16/16	-
5	PEG	A	304	-	-	1/4/4/4	-
4	CIT	A	302	-	-	14/16/16/16	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	302	CIT	O4-C5	-2.22	1.23	1.30

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	301	CIT	O6-C6-C3	4.41	120.70	113.05
4	A	302	CIT	O6-C6-C3	3.98	119.96	113.05
4	A	302	CIT	O7-C3-C6	-2.82	104.90	108.86
4	A	302	CIT	O4-C5-O3	-2.64	116.72	123.30
4	A	302	CIT	C3-C2-C1	-2.38	108.04	113.81
4	A	301	CIT	O2-C1-C2	2.04	120.90	114.35

There are no chirality outliers.

All (26) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	301	CIT	O7-C3-C6-O5
4	A	301	CIT	O7-C3-C6-O6
4	A	301	CIT	C4-C3-C6-O5
4	A	301	CIT	C4-C3-C6-O6
4	A	302	CIT	C2-C3-C4-C5
4	A	302	CIT	O7-C3-C4-C5
4	A	302	CIT	C6-C3-C4-C5
4	A	302	CIT	C2-C3-C6-O5
4	A	302	CIT	C2-C3-C6-O6
4	A	302	CIT	O7-C3-C6-O5
4	A	302	CIT	O7-C3-C6-O6
4	A	302	CIT	C1-C2-C3-C6
4	A	301	CIT	C1-C2-C3-O7
4	A	301	CIT	C1-C2-C3-C4
4	A	302	CIT	C1-C2-C3-C4
4	A	301	CIT	C1-C2-C3-C6
5	A	303	PEG	C1-C2-O2-C3

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Mol	Chain	Res	Type	Atoms
5	A	303	PEG	C4-C3-O2-C2
4	A	302	CIT	C4-C3-C6-O5
4	A	302	CIT	O2-C1-C2-C3
4	A	302	CIT	O1-C1-C2-C3
4	A	301	CIT	C2-C3-C6-O5
4	A	302	CIT	C4-C3-C6-O6
5	A	304	PEG	C4-C3-O2-C2
5	A	303	PEG	O1-C1-C2-O2
4	A	302	CIT	C1-C2-C3-O7

There are no ring outliers.

2 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	303	PEG	5	0
4	A	301	CIT	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, 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	H	224/235 (95%)	0.04	7 (3%) 51 55	9, 23, 48, 61	3 (1%)
2	L	212/217 (97%)	0.74	24 (11%) 11 10	16, 35, 63, 79	2 (0%)
3	A	215/220 (97%)	-0.07	6 (2%) 55 58	13, 22, 43, 62	1 (0%)
All	All	651/672 (96%)	0.23	37 (5%) 30 32	9, 26, 56, 79	6 (0%)

All (37) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	L	8	PRO	4.1
2	L	187	ALA	3.9
2	L	184	LEU	3.8
2	L	12	ALA	3.8
2	L	13	VAL	3.7
2	L	157	LEU	3.4
2	L	7	SER	3.4
3	A	219	HIS	3.4
2	L	60	SER	3.2
1	H	150	GLY	3.2
2	L	153	VAL	3.1
3	A	220	HIS	3.1
2	L	197	CYS	3.1
2	L	208	VAL	3.1
2	L	131	GLY	3.1
1	H	132	THR	3.0
2	L	81	SER	3.0
2	L	194	VAL	2.9
2	L	215	GLY	2.8
2	L	132	THR	2.7
3	A	98	ALA	2.7
1	H	221	THR	2.6
2	L	33	TYR	2.6

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Mol	Chain	Res	Type	RSRZ
1	H	220	ASN	2.6
1	H	230	LYS	2.5
2	L	130	SER	2.4
2	L	15	LEU	2.3
3	A	218	HIS	2.3
2	L	84	ALA	2.3
2	L	156	ALA	2.3
3	A	23	VAL	2.2
2	L	191	LYS	2.2
2	L	193	LYS	2.2
1	H	143	SER	2.1
2	L	188	ASP	2.0
3	A	24	ARG	2.0
1	H	134	GLY	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 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( $\text{\AA}^2$ )	Q<0.9
4	CIT	A	302	13/13	0.83	0.13	31,40,51,64	0
5	PEG	A	304	7/7	0.84	0.15	37,42,52,61	0
4	CIT	A	301	13/13	0.86	0.15	21,57,71,88	0
5	PEG	A	303	7/7	0.89	0.12	27,35,47,59	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.