wwPDB X-ray Structure Validation Summary Report (i)

Oct 19, 2026 – 03:34 PM JST

PDB ID	:	45CQ / pdb_000045cq
Title	:	F306, a fluorinated amino acid-containing CI2 variant, bound to alpha-chymotrypsin
Authors	:	Sengoku, T.; Beattie, A.; Suga, H.
Deposited on	:	2026-08-24
Resolution	:	1.87 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 (i) 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 (1)) were used in the production of this report:

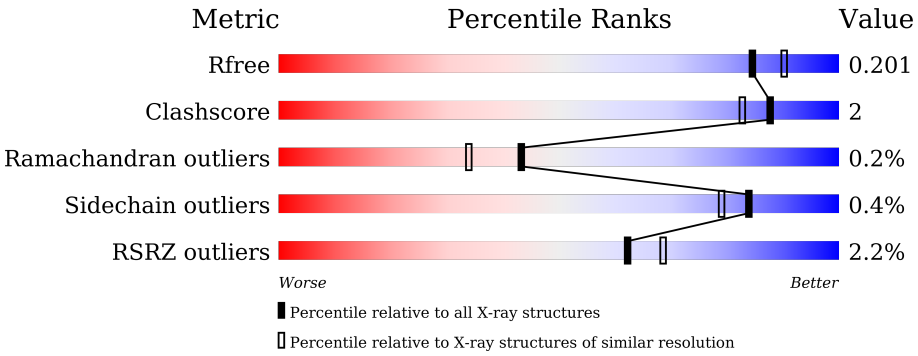
MolProbity	:	4-5-2 with Phenix2.2
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	2.2
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.51

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 1.87 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	1220 (1.88-1.88)
Clashscore	190562	1234 (1.88-1.88)
Ramachandran outliers	187476	1222 (1.88-1.88)
Sidechain outliers	187428	1222 (1.88-1.88)
RSRZ outliers	180081	1220 (1.88-1.88)

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	E	13	8% 92% 8%
1	G	13	15% 92% 8%
2	A	131	98% .
2	B	131	2% 97% .
3	D	98	4% 94% 6%
3	F	98	4% 94% 6%

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Mol	Chain	Length	Quality of chain
4	C	64	
4	I	64	

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 10113 atoms, of which 4608 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 Chymotrypsinogen A.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	E	12	Total	C	H	N	O	S	0	0	0
			162	50	84	13	14	1			
1	G	12	Total	C	H	N	O	S	0	0	0
			162	50	84	13	14	1			

- Molecule 2 is a protein called Chymotrypsin A chain B.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	A	131	Total	C	H	N	O	S	0	3	0
			1952	625	961	163	198	5			
2	B	131	Total	C	H	N	O	S	0	3	0
			1952	625	961	163	198	5			

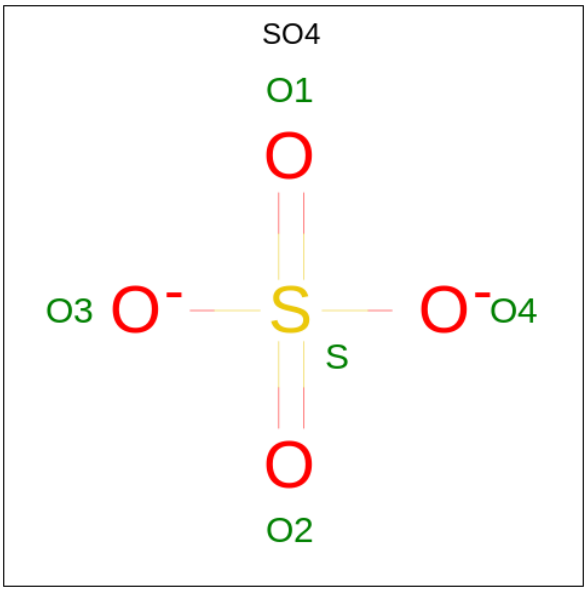
- Molecule 3 is a protein called Chymotrypsinogen A.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
3	D	98	Total	C	H	N	O	S	0	5	0
			1452	453	723	125	143	8			
3	F	98	Total	C	H	N	O	S	0	5	0
			1452	453	723	125	143	8			

- Molecule 4 is a protein called F306.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
4	I	64	Total	C	F	H	N	O	0	1	0
			1067	332	14	539	89	93			
4	C	64	Total	C	F	H	N	O	0	1	0
			1061	331	16	533	87	94			

- Molecule 5 is SULFATE ION (CCD ID: SO4) (formula: O_4S).



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

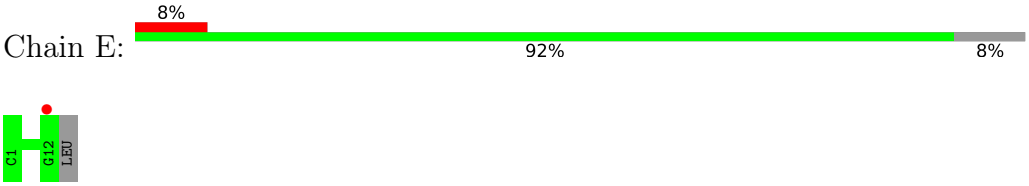
- Molecule 6 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	E	25	Total O 25 25	0	0
6	A	205	Total O 205 205	0	0
6	D	111	Total O 111 111	0	0
6	I	111	Total O 111 111	0	0
6	G	21	Total O 21 21	0	0
6	B	157	Total O 157 157	0	0
6	F	102	Total O 102 102	0	0
6	C	106	Total O 106 106	0	0

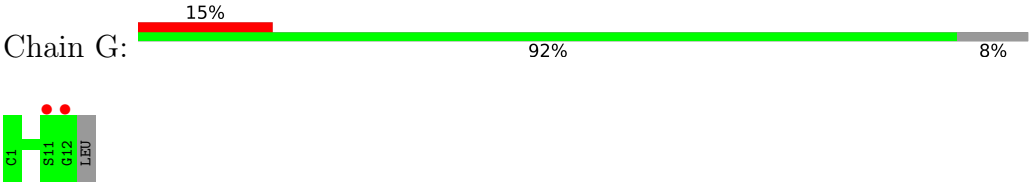
3 Residue-property plots (i)

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.

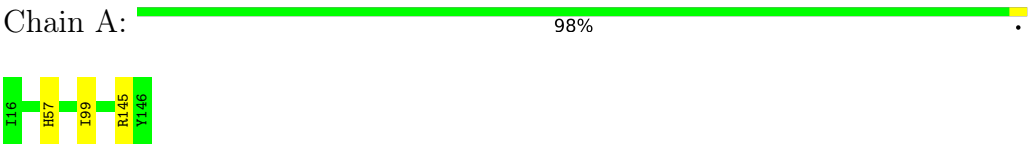
• Molecule 1: Chymotrypsinogen A



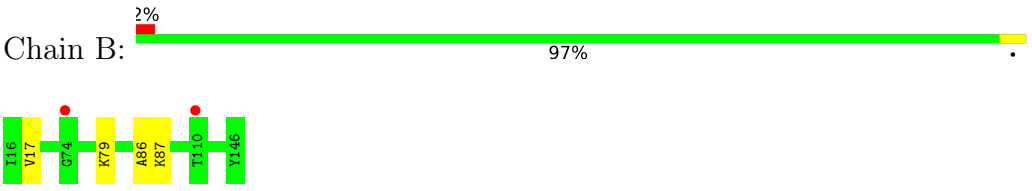
• Molecule 1: Chymotrypsinogen A



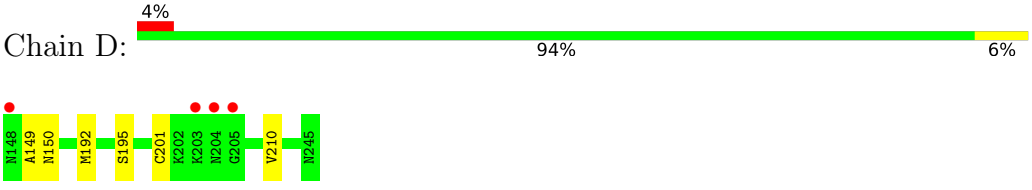
• Molecule 2: Chymotrypsin A chain B



• Molecule 2: Chymotrypsin A chain B

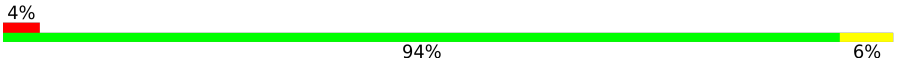


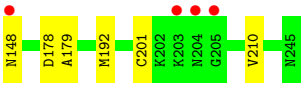
• Molecule 3: Chymotrypsinogen A



• Molecule 3: Chymotrypsinogen A

Chain F:

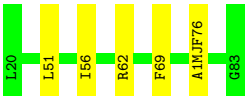




• Molecule 4: F306

Chain I:

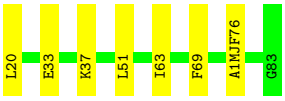




• Molecule 4: F306

Chain C:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	67.36Å 74.96Å 117.90Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	46.34 – 1.87 46.34 – 1.87	Depositor EDS
% Data completeness (in resolution range)	100.0 (46.34-1.87) 100.0 (46.34-1.87)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.62 (at 1.87Å)	Xtriage
Refinement program	PHENIX (1.21.2_5419: ???)	Depositor
R, R_{free}	0.157 , 0.197 0.163 , 0.201	Depositor DCC
R_{free} test set	2000 reflections (4.00%)	wwPDB-VP
Wilson B-factor (Å^2)	8.7	Xtriage
Anisotropy	0.546	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.41 , 48.3	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	10113	wwPDB-VP
Average B, all atoms (Å^2)	14.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.43% of the height of the origin peak. No significant pseudotranslation is detected.*

[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: NLE, A1MJG, OBF, SO4, PFF, A1MJF, 3EG

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	E	0.28	0/79	0.36	0/108
1	G	0.23	0/79	0.41	0/108
2	A	0.28	0/1017	0.44	0/1385
2	B	0.24	0/1017	0.41	0/1385
3	D	0.30	0/757	0.48	0/1029
3	F	0.25	0/757	0.42	0/1029
4	C	0.29	0/453	0.50	0/602
4	I	0.28	0/464	0.47	0/616
All	All	0.27	0/4623	0.44	0/6262

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	E	78	84	84	0	0
1	G	78	84	84	0	0
2	A	991	961	964	2	0
2	B	991	961	964	3	0
3	D	729	723	732	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	F	729	723	732	3	0
4	C	528	533	510	7	0
4	I	528	539	519	3	0
5	A	10	0	0	0	0
5	I	5	0	0	0	0
6	A	205	0	0	0	0
6	B	157	0	0	0	0
6	C	106	0	0	0	0
6	D	111	0	0	0	0
6	E	25	0	0	0	0
6	F	102	0	0	0	0
6	G	21	0	0	0	0
6	I	111	0	0	1	0
All	All	5505	4608	4589	18	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 2.

The worst 5 of 18 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)
4:C:37:LYS:N	4:C:37:LYS:HD3	2.16	0.61
3:F:148:ASN:O	4:C:20:NLE:HE3	2.09	0.52
4:C:33:GLU:H	4:C:33:GLU:CD	2.22	0.47
3:D:201:CYS:SG	3:D:210:VAL:HG21	2.56	0.46
2:A:145:ARG:HD2	2:B:17:VAL:CG1	2.47	0.45

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	E	10/13 (77%)	10 (100%)	0	0	100 100
1	G	10/13 (77%)	10 (100%)	0	0	100 100
2	A	132/131 (101%)	129 (98%)	2 (2%)	1 (1%)	16 5
2	B	132/131 (101%)	130 (98%)	2 (2%)	0	100 100
3	D	101/98 (103%)	99 (98%)	2 (2%)	0	100 100
3	F	101/98 (103%)	100 (99%)	1 (1%)	0	100 100
4	C	56/64 (88%)	55 (98%)	1 (2%)	0	100 100
4	I	57/64 (89%)	56 (98%)	1 (2%)	0	100 100
All	All	599/612 (98%)	589 (98%)	9 (2%)	1 (0%)	43 34

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	A	99	ILE

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	E	9/10 (90%)	9 (100%)	0	100 100
1	G	9/10 (90%)	9 (100%)	0	100 100
2	A	112/109 (103%)	112 (100%)	0	100 100
2	B	112/109 (103%)	112 (100%)	0	100 100
3	D	83/78 (106%)	81 (98%)	2 (2%)	43 27
3	F	83/78 (106%)	81 (98%)	2 (2%)	43 27
4	C	50/50 (100%)	50 (100%)	0	100 100
4	I	51/50 (102%)	51 (100%)	0	100 100
All	All	509/494 (103%)	505 (99%)	4 (1%)	84 68

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	D	192[A]	MET
3	D	192[B]	MET
3	F	192[A]	MET
3	F	192[B]	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
2	A	116	GLN
2	B	34	GLN
3	F	148	ASN
4	C	41	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)

11 non-standard protein/DNA/RNA residues 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	OBF	C	27[B]	4	5,7,8	0.71	0	2,8,10	0.25	0
4	OBF	C	27[A]	4	5,7,8	0.64	0	2,8,10	0.27	0
4	A1MJF	I	76	4	7,10,11	4.76	3 (42%)	4,15,17	9.16	3 (75%)
4	NLE	I	20	4	6,7,8	0.45	0	2,7,9	0.20	0
4	A1MJF	C	76	4	7,10,11	4.83	3 (42%)	4,15,17	8.74	3 (75%)
4	3EG	I	66	4	7,8,9	0.69	0	6,11,13	0.13	0
4	PFF	I	48	4	11,12,13	0.51	0	12,15,17	0.33	0
4	3EG	C	66	4	7,8,9	0.88	0	6,11,13	0.20	0
4	NLE	C	20	4	6,7,8	0.52	0	2,7,9	0.09	0
4	PFF	C	48	4	11,12,13	0.40	0	12,15,17	0.19	0
4	OBF	I	27	4	5,7,8	0.73	0	2,8,10	0.47	0

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
4	OBF	C	27[B]	4	-	0/5/6/8	-
4	OBF	C	27[A]	4	-	0/5/6/8	-
4	A1MJF	I	76	4	-	0/1/16/18	0/1/1/1
4	NLE	I	20	4	-	1/5/6/8	-
4	A1MJF	C	76	4	-	0/1/16/18	0/1/1/1
4	3EG	I	66	4	-	1/4/7/9	-
4	PFF	I	48	4	-	0/5/6/8	0/1/1/1
4	3EG	C	66	4	-	1/4/7/9	-
4	NLE	C	20	4	-	1/5/6/8	-
4	PFF	C	48	4	-	0/5/6/8	0/1/1/1
4	OBF	I	27	4	-	0/5/6/8	-

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	76	A1MJF	CG2-CB	-8.92	1.44	1.55
4	I	76	A1MJF	CG1-CB	-8.64	1.44	1.55
4	I	76	A1MJF	CG2-CB	-8.20	1.45	1.55
4	C	76	A1MJF	CG1-CB	-8.07	1.45	1.55
4	C	76	A1MJF	CB-CA	3.31	1.59	1.53

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	I	76	A1MJF	CG2-CB-CG1	17.49	103.65	87.49
4	C	76	A1MJF	CG2-CB-CG1	16.52	102.75	87.49
4	C	76	A1MJF	CG2-CD1-CG1	-4.83	84.24	89.74
4	I	76	A1MJF	CG2-CD1-CG1	-4.10	85.08	89.74
4	I	76	A1MJF	F02-CD1-F01	3.10	113.86	107.49

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	I	20	NLE	C-CA-CB-CG
4	I	66	3EG	O-C-CA-CB
4	C	66	3EG	O-C-CA-CB
4	C	20	NLE	C-CA-CB-CG

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	C	20	NLE	2	0

5.5 Carbohydrates (i)

There are no oligosaccharides in this entry.

5.6 Ligand geometry (i)

3 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	SO4	A	301	-	4,4,4	0.60	0	6,6,6	0.08	0
5	SO4	A	302	-	4,4,4	0.62	0	6,6,6	0.10	0
5	SO4	I	101	-	4,4,4	0.59	0	6,6,6	0.14	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

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^{th} 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	E	12/13 (92%)	0.12	1 (8%) 17 19	7, 12, 31, 38	0
1	G	12/13 (92%)	0.59	2 (16%) 4 5	14, 18, 44, 59	0
2	A	131/131 (100%)	-0.72	0 100 100	2, 7, 23, 40	3 (2%)
2	B	131/131 (100%)	-0.36	2 (1%) 72 77	4, 14, 34, 52	3 (2%)
3	D	98/98 (100%)	-0.65	4 (4%) 41 45	2, 6, 28, 48	5 (5%)
3	F	98/98 (100%)	-0.50	4 (4%) 41 45	4, 12, 34, 58	5 (5%)
4	C	57/64 (89%)	-0.49	0 100 100	6, 12, 32, 41	0
4	I	57/64 (89%)	-0.60	0 100 100	4, 10, 29, 37	1 (1%)
All	All	596/612 (97%)	-0.52	13 (2%) 62 68	2, 10, 31, 59	17 (2%)

The worst 5 of 13 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	G	12	GLY	4.9
3	D	148	ASN	4.8
2	B	110	THR	4.1
3	F	148	ASN	3.6
1	G	11	SER	3.5

6.2 Non-standard residues in protein, DNA, RNA chains

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^{th} 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	NLE	C	20	8/9	0.69	0.24	30,53,74,77	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
4	NLE	I	20	8/9	0.91	0.12	16,33,40,42	0
4	OBF	I	27	8/9	0.94	0.07	5,7,11,27	0
4	OBF	C	27[A]	8/9	0.95	0.05	5,6,7,8	13
4	OBF	C	27[B]	8/9	0.95	0.05	5,6,8,8	13
4	A1MJF	I	76	10/11	0.95	0.06	5,8,13,17	0
4	A1MJF	C	76	10/11	0.95	0.06	6,8,11,15	0
4	PFF	I	48	12/13	0.96	0.06	4,7,10,10	0
4	PFF	C	48	12/13	0.97	0.05	7,9,11,12	0
4	3EG	C	66	9/10	0.97	0.05	6,8,10,12	0
4	3EG	I	66	9/10	0.98	0.04	3,4,7,7	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^{th} 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
5	SO4	A	301	5/5	0.91	0.14	34,36,50,61	0
5	SO4	A	302	5/5	0.93	0.14	15,34,48,54	0
5	SO4	I	101	5/5	0.94	0.17	26,29,40,59	0

6.5 Other polymers (i)

There are no such residues in this entry.