



wwPDB X-ray Structure Validation Summary Report ⓘ

Jan 30, 2024 – 09:46 AM EST

PDB ID : 1FUI
Title : L-FUCOSE ISOMERASE FROM ESCHERICHIA COLI
Authors : Seemann, J.E.; Schulz, G.E.
Deposited on : 1997-04-14
Resolution : 2.50 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>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.36
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

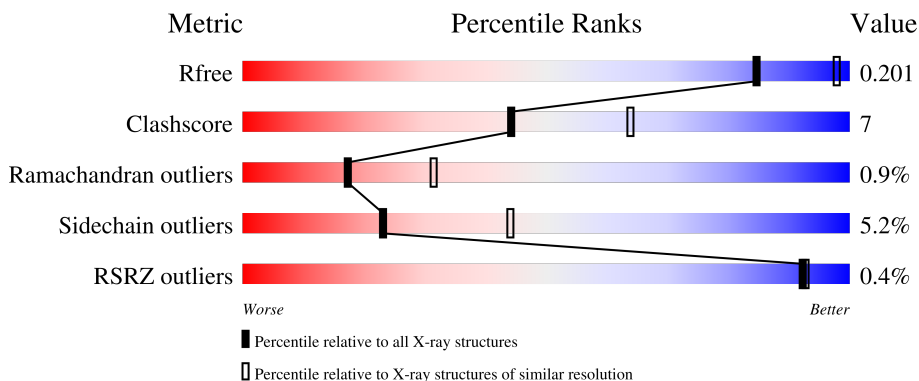
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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.



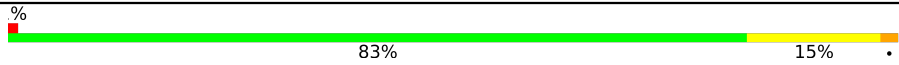
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)

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 ≥ 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	591	84% 14% .
1	B	591	85% 13% .
1	C	591	86% 12% .
1	D	591	85% 13% .
1	E	591	85% 13% .

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Mol	Chain	Length	Quality of chain
1	F	591	 <p>A horizontal bar chart representing the quality of the chain. The bar is divided into two segments: a green segment on the left labeled '83%' and a yellow segment on the right labeled '15%'. A small red square is at the beginning of the bar, and a small black dot is at the end. A '%' symbol is positioned above the bar.</p>

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 28295 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 L-FUCOSE ISOMERASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	591	4557	2853	803	866	35	50	0	0
1	B	591	4557	2853	803	866	35	78	0	0
1	C	591	4557	2853	803	866	35	132	0	0
1	D	591	4557	2853	803	866	35	198	0	0
1	E	591	4557	2853	803	866	35	100	0	0
1	F	591	4557	2853	803	866	35	115	0	0

- Molecule 2 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

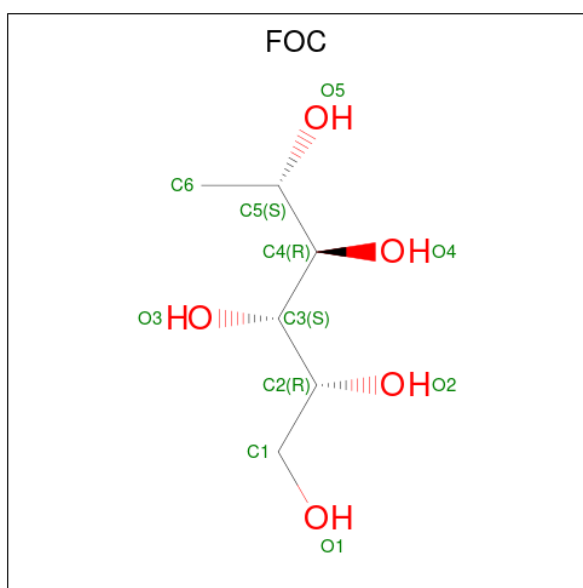
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Mn	0	0
			1	1		
2	B	1	Total	Mn	0	0
			1	1		
2	C	1	Total	Mn	0	0
			1	1		
2	D	1	Total	Mn	0	0
			1	1		
2	E	1	Total	Mn	0	0
			1	1		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



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

- Molecule 4 is FUCITOL (three-letter code: FOC) (formula: $C_6H_{14}O_5$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	O	0	0
			11	6	5		
4	B	1	Total	C	O	0	0
			11	6	5		

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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	C	1	Total C O 11 6 5	0	0
4	D	1	Total C O 11 6 5	0	0
4	E	1	Total C O 11 6 5	0	0
4	F	1	Total C O 11 6 5	0	0

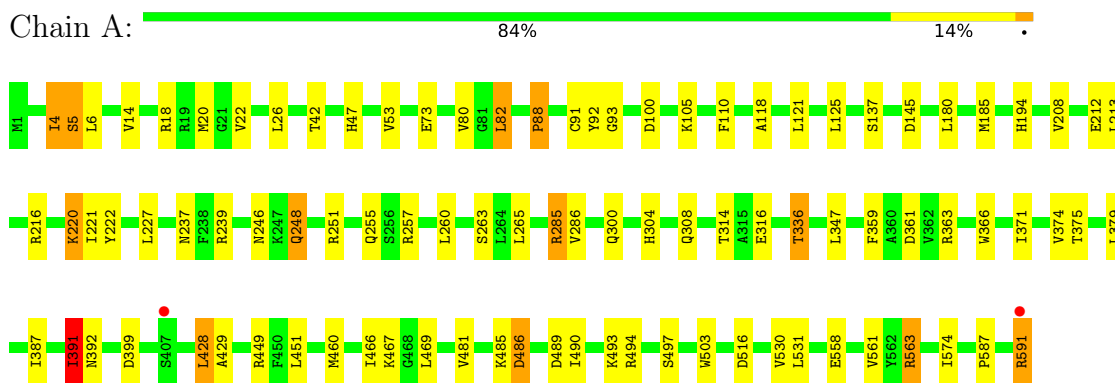
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	163	Total O 163 163	0	0
5	B	126	Total O 126 126	0	0
5	C	158	Total O 158 158	0	0
5	D	142	Total O 142 142	0	0
5	E	152	Total O 152 152	0	0
5	F	131	Total O 131 131	0	0

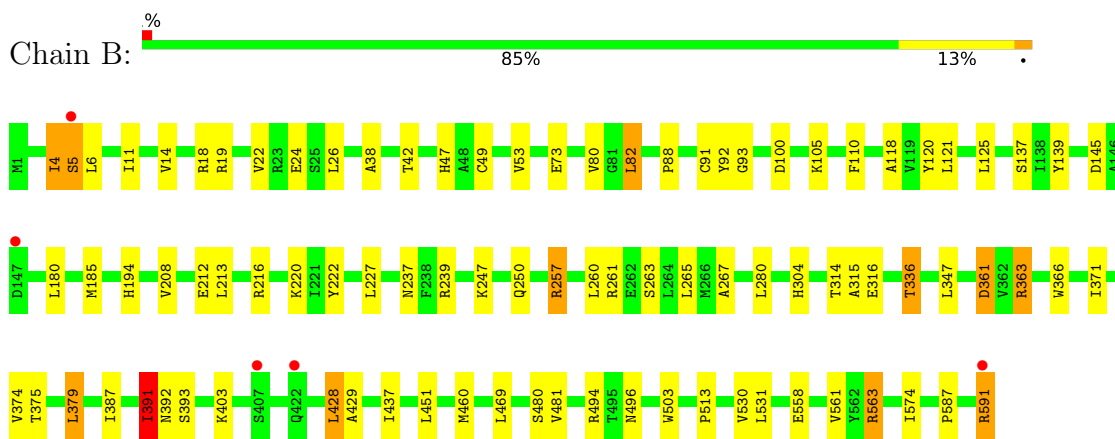
3 Residue-property plots

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.

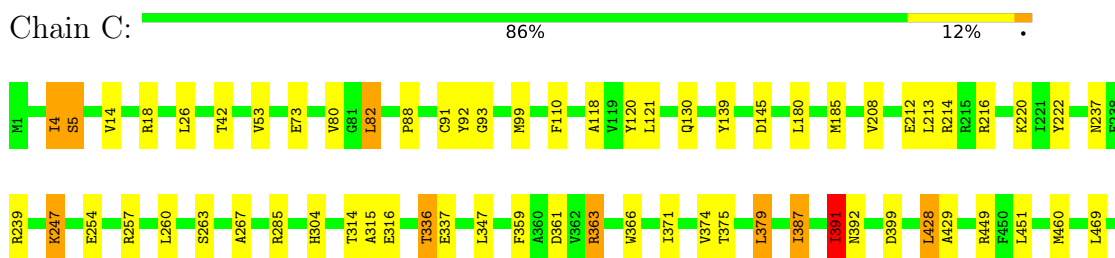
● Molecule 1: L-FUCOSE ISOMERASE



● Molecule 1: L-FUCOSE ISOMERASE

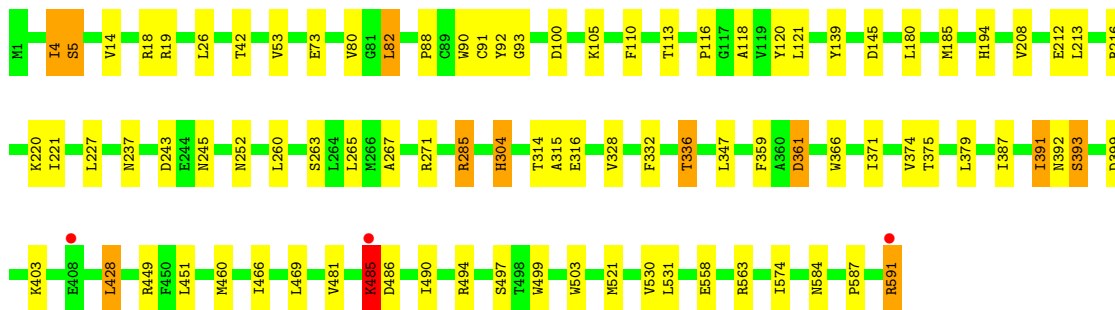
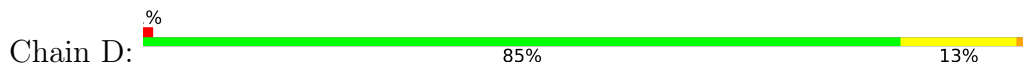


● Molecule 1: L-FUCOSE ISOMERASE

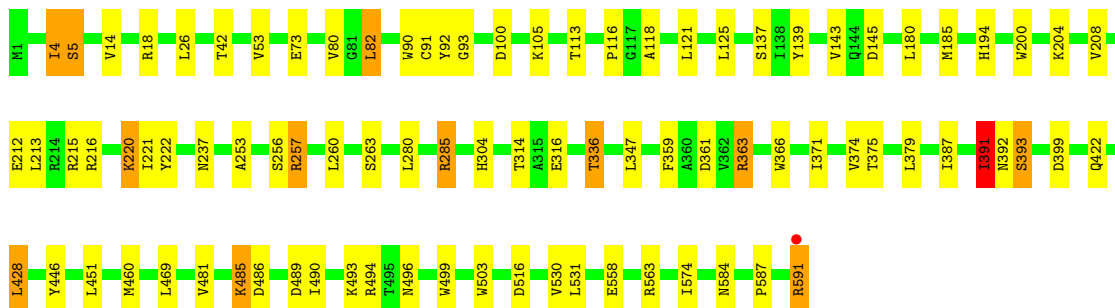
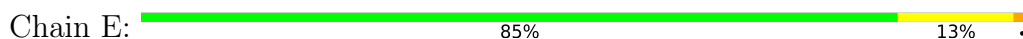




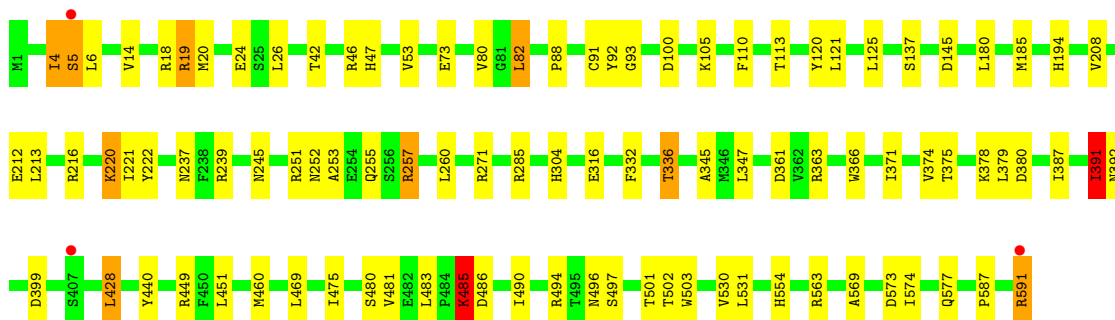
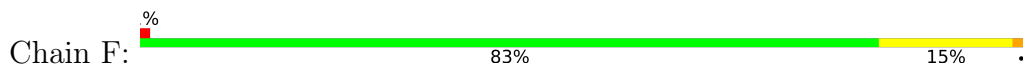
• Molecule 1: L-FUCOSE ISOMERASE



• Molecule 1: L-FUCOSE ISOMERASE



• Molecule 1: L-FUCOSE ISOMERASE



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	127.30Å 128.30Å 239.40Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.50 19.94 – 2.49	Depositor EDS
% Data completeness (in resolution range)	87.0 (20.00-2.50) 86.8 (19.94-2.49)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$	-	Xtrriage
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.162 , 0.209 0.154 , 0.201	Depositor DCC
R_{free} test set	1196 reflections (1.01%)	wwPDB-VP
Wilson B-factor (Å ²)	29.9	Xtrriage
Anisotropy	0.317	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 56.6	EDS
L-test for twinning ¹	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	0.014 for k,h,-l	Xtrriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	28295	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.04% of the height of the origin peak. No significant pseudotranslation is detected.*

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: FOC, SO4, MN

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	0.50	0/4657	0.71	2/6308 (0.0%)
1	B	0.47	0/4657	0.69	3/6308 (0.0%)
1	C	0.51	0/4657	0.70	2/6308 (0.0%)
1	D	0.49	0/4657	0.70	1/6308 (0.0%)
1	E	0.48	0/4657	0.70	2/6308 (0.0%)
1	F	0.50	0/4657	0.70	3/6308 (0.0%)
All	All	0.49	0/27942	0.70	13/37848 (0.0%)

There are no bond length outliers.

The worst 5 of 13 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	82	LEU	CA-CB-CG	7.38	132.28	115.30
1	A	82	LEU	CA-CB-CG	7.32	132.13	115.30
1	D	82	LEU	CA-CB-CG	7.06	131.53	115.30
1	F	82	LEU	CA-CB-CG	6.80	130.95	115.30
1	B	82	LEU	CA-CB-CG	6.37	129.95	115.30

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	4557	0	4434	71	0
1	B	4557	0	4434	65	0
1	C	4557	0	4434	61	0
1	D	4557	0	4434	64	0
1	E	4557	0	4434	65	0
1	F	4557	0	4434	76	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
2	E	1	0	0	0	0
3	A	5	0	0	0	0
3	D	5	0	0	0	0
4	A	11	0	13	0	0
4	B	11	0	12	0	0
4	C	11	0	12	1	0
4	D	11	0	12	0	0
4	E	11	0	13	0	0
4	F	11	0	13	1	0
5	A	163	0	0	6	0
5	B	126	0	0	4	0
5	C	158	0	0	4	0
5	D	142	0	0	5	0
5	E	152	0	0	3	0
5	F	131	0	0	6	0
All	All	28295	0	26679	347	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 7.

The worst 5 of 347 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:F:14:VAL:HG12	1:F:91:CYS:SG	2.07	0.94
1:D:14:VAL:HG12	1:D:91:CYS:SG	2.06	0.94
1:E:14:VAL:HG12	1:E:91:CYS:SG	2.07	0.94
1:E:221:ILE:HG23	1:E:285:ARG:HG2	1.48	0.92
1:A:14:VAL:HG12	1:A:91:CYS:SG	2.11	0.90

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	589/591 (100%)	567 (96%)	17 (3%)	5 (1%)	19	35
1	B	589/591 (100%)	562 (95%)	22 (4%)	5 (1%)	19	35
1	C	589/591 (100%)	561 (95%)	24 (4%)	4 (1%)	22	39
1	D	589/591 (100%)	557 (95%)	24 (4%)	8 (1%)	11	20
1	E	589/591 (100%)	561 (95%)	22 (4%)	6 (1%)	15	28
1	F	589/591 (100%)	556 (94%)	28 (5%)	5 (1%)	19	35
All	All	3534/3546 (100%)	3364 (95%)	137 (4%)	33 (1%)	17	31

5 of 33 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	93	GLY
1	B	93	GLY
1	C	5	SER
1	D	93	GLY
1	E	93	GLY

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	474/474 (100%)	450 (95%)	24 (5%)	24	45
1	B	474/474 (100%)	452 (95%)	22 (5%)	27	50
1	C	474/474 (100%)	448 (94%)	26 (6%)	21	41

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	474/474 (100%)	449 (95%)	25 (5%)	22	43
1	E	474/474 (100%)	450 (95%)	24 (5%)	24	45
1	F	474/474 (100%)	447 (94%)	27 (6%)	20	39
All	All	2844/2844 (100%)	2696 (95%)	148 (5%)	23	44

5 of 148 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	451	LEU
1	F	469	LEU
1	E	531	LEU
1	F	213	LEU
1	C	80	VAL

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	E	130	GLN
1	F	194	HIS
1	B	392	ASN
1	C	130	GLN
1	C	392	ASN

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 monosaccharides in this entry.

5.6 Ligand geometry

Of 13 ligands modelled in this entry, 5 are monoatomic - leaving 8 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
4	FOC	F	592	-	9,10,10	1.01	1 (11%)	10,13,13	0.85	0
4	FOC	B	593	2	9,10,10	0.87	1 (11%)	10,13,13	0.74	0
4	FOC	D	594	2	9,10,10	0.92	1 (11%)	10,13,13	0.82	0
4	FOC	C	593	2	9,10,10	0.86	1 (11%)	10,13,13	0.90	0
3	SO4	D	593	-	4,4,4	0.62	0	6,6,6	0.85	0
3	SO4	A	593	-	4,4,4	0.68	0	6,6,6	0.80	0
4	FOC	E	593	2	9,10,10	0.84	0	10,13,13	0.77	0
4	FOC	A	594	2	9,10,10	0.88	0	10,13,13	0.74	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	FOC	F	592	-	-	8/14/14/14	-
4	FOC	B	593	2	-	8/14/14/14	-
4	FOC	D	594	2	-	9/14/14/14	-
4	FOC	C	593	2	-	9/14/14/14	-
4	FOC	E	593	2	-	8/14/14/14	-
4	FOC	A	594	2	-	9/14/14/14	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	F	592	FOC	O1-C1	-2.16	1.33	1.42
4	C	593	FOC	O1-C1	-2.13	1.33	1.42
4	D	594	FOC	O1-C1	-2.07	1.33	1.42
4	B	593	FOC	O1-C1	-2.05	1.33	1.42

There are no bond angle outliers.

There are no chirality outliers.

5 of 51 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	594	FOC	O1-C1-C2-O2
4	A	594	FOC	O1-C1-C2-C3
4	B	593	FOC	O1-C1-C2-O2
4	B	593	FOC	O1-C1-C2-C3
4	C	593	FOC	O1-C1-C2-O2

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	F	592	FOC	1	0
4	C	593	FOC	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 [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	587/591 (99%)	-0.95	2 (0%) 94 94	12, 25, 53, 80	3 (0%)
1	B	587/591 (99%)	-0.83	5 (0%) 84 86	13, 32, 58, 79	9 (1%)
1	C	581/591 (98%)	-0.92	1 (0%) 95 95	11, 26, 59, 77	9 (1%)
1	D	569/591 (96%)	-0.84	3 (0%) 91 91	12, 29, 60, 97	3 (0%)
1	E	586/591 (99%)	-0.91	1 (0%) 95 95	11, 26, 59, 78	11 (1%)
1	F	583/591 (98%)	-0.80	3 (0%) 91 91	14, 31, 61, 87	10 (1%)
All	All	3493/3546 (98%)	-0.87	15 (0%) 92 93	11, 28, 59, 97	45 (1%)

The worst 5 of 15 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	591	ARG	4.6
1	B	591	ARG	4.6
1	E	591	ARG	4.5
1	F	591	ARG	4.2
1	A	591	ARG	4.1

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 monosaccharides 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, 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	FOC	F	592	11/11	0.78	0.24	55,72,77,87	0
4	FOC	A	594	11/11	0.86	0.21	56,69,77,82	0
4	FOC	D	594	11/11	0.88	0.29	68,71,83,88	0
4	FOC	B	593	11/11	0.89	0.28	59,77,84,86	0
4	FOC	C	593	11/11	0.90	0.20	67,74,77,83	0
2	MN	C	592	1/1	0.92	0.05	43,43,43,43	0
4	FOC	E	593	11/11	0.93	0.18	43,63,69,77	0
2	MN	D	592	1/1	0.96	0.05	49,49,49,49	0
2	MN	B	592	1/1	0.97	0.03	41,41,41,41	0
2	MN	A	592	1/1	0.98	0.04	39,39,39,39	0
2	MN	E	592	1/1	0.98	0.04	31,31,31,31	0
3	SO4	A	593	5/5	1.00	0.05	12,12,21,22	0
3	SO4	D	593	5/5	1.00	0.06	17,20,22,25	0

6.5 Other polymers [i](#)

There are no such residues in this entry.