



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 07:07 PM UTC

PDB ID : 5EEB / pdb_00005eeb
Title : Apo form of thermostable aldehyde dehydrogenase from *Pyrobaculum* sp. 1860
Authors : Petrova, T.E.; Bezsudnova, E.Y.; Boyko, K.M.; Mardanov, A.V.; Gumerov, V.M.; Ravin, N.V.; Popov, V.O.
Deposited on : 2015-10-22
Resolution : 3.04 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 : 4-5-2 with Phenix2.0
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
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) : 2.49

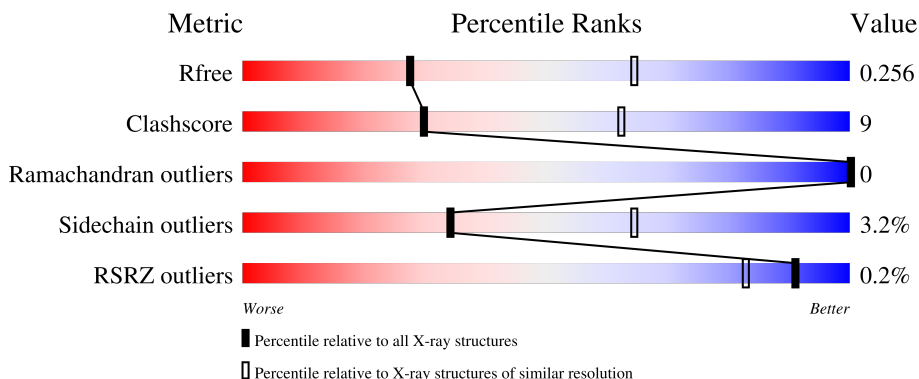
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.04 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	3685 (3.08-3.00)
Clashscore	190562	4007 (3.08-3.00)
Ramachandran outliers	187476	3834 (3.08-3.00)
Sidechain outliers	187428	3836 (3.08-3.00)
RSRZ outliers	180081	3684 (3.08-3.00)

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 ≥ 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	491	75% 23% ..
1	B	491	77% 20% ..
1	C	491	78% 19% ..
1	D	491	72% 25% ..
1	E	491	75% 23% ..

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
1	F	491	 73% 24% ..
1	G	491	 75% 22% ..
1	H	491	 78% 20% .

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 30043 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.

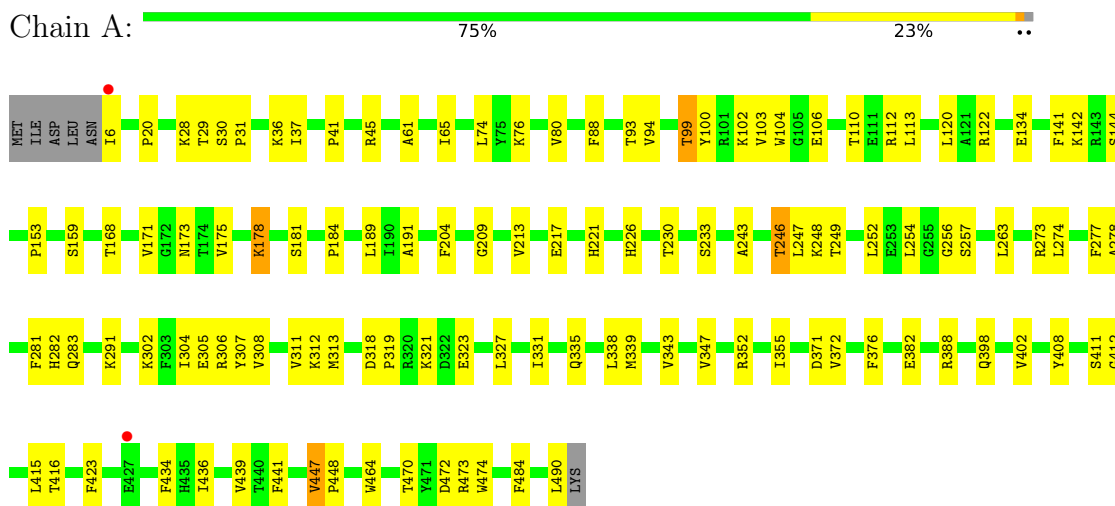
- Molecule 1 is a protein called Aldehyde dehydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	485	3760	2398	656	696	10	0	0	0
1	B	484	3760	2398	656	695	11	0	0	0
1	C	484	3756	2395	655	695	11	0	0	0
1	D	483	3746	2390	654	692	10	0	0	0
1	E	484	3762	2400	656	695	11	0	0	0
1	F	483	3752	2393	655	694	10	0	0	0
1	G	484	3760	2398	656	695	11	0	0	0
1	H	482	3747	2390	654	693	10	0	0	0

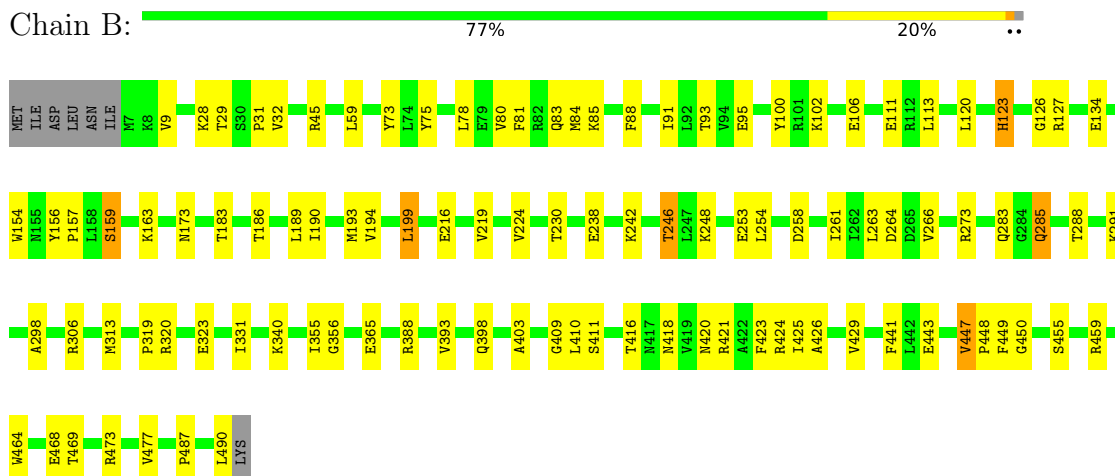
3 Residue-property plots

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.

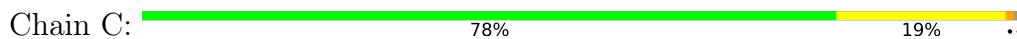
- Molecule 1: Aldehyde dehydrogenase



- Molecule 1: Aldehyde dehydrogenase



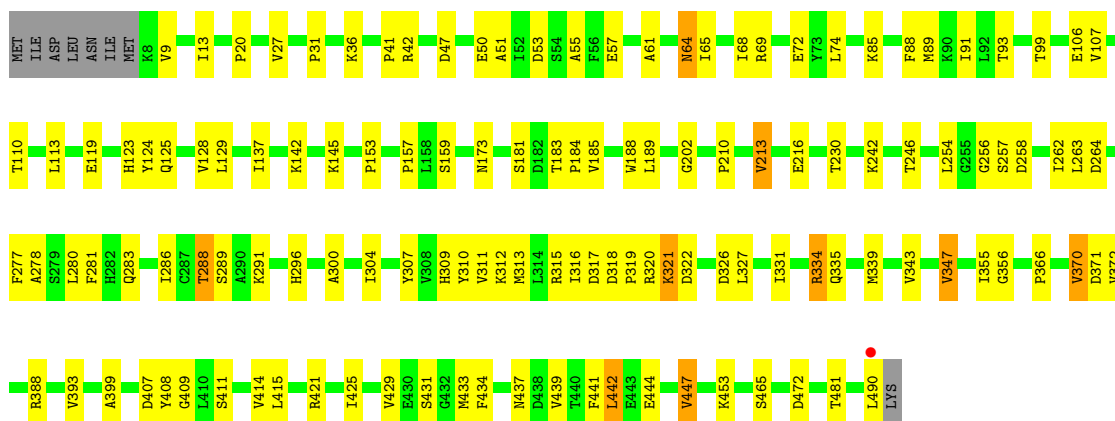
- Molecule 1: Aldehyde dehydrogenase





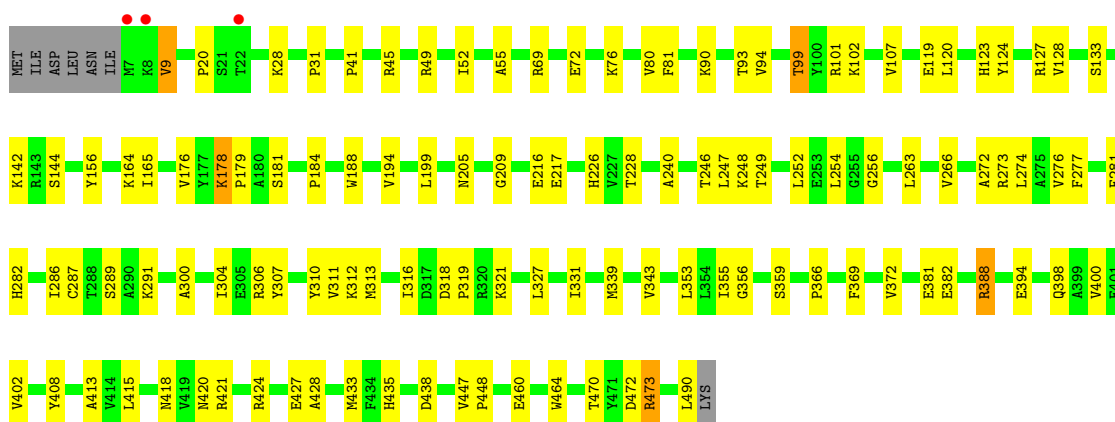
- Molecule 1: Aldehyde dehydrogenase

Chain D: 72% 25%



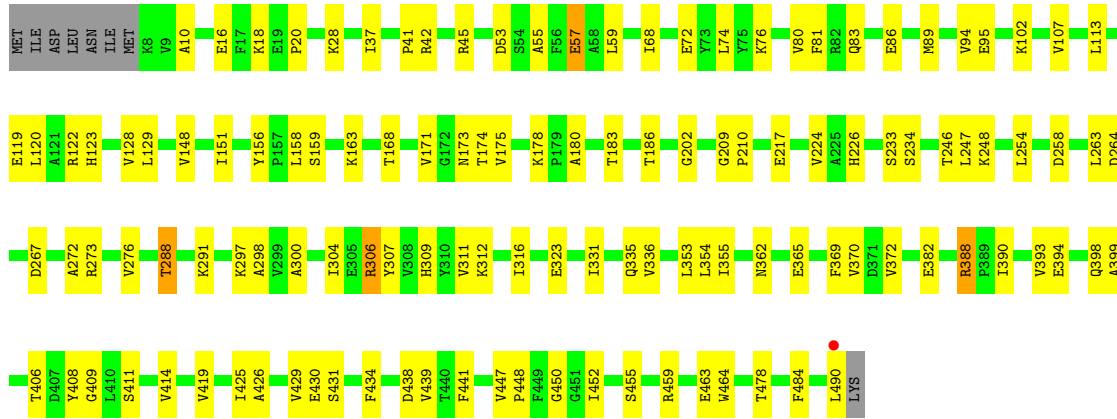
- Molecule 1: Aldehyde dehydrogenase

Chain E: 75% 23%

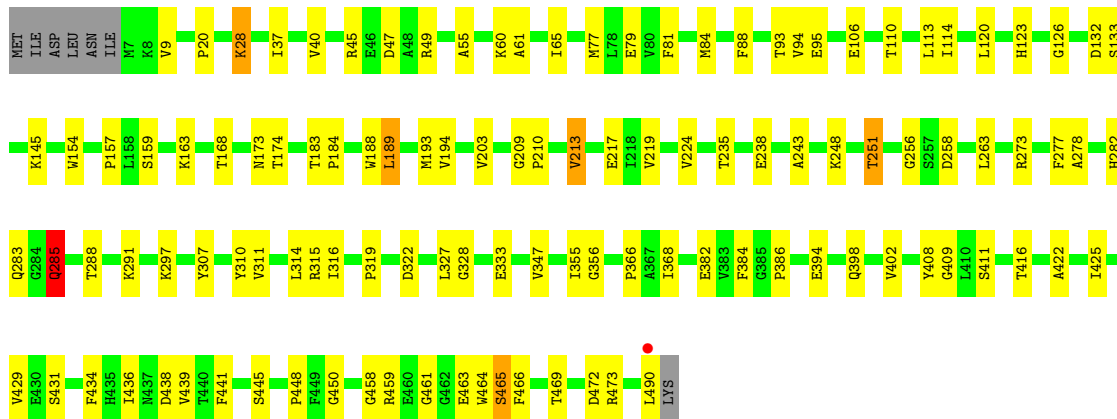
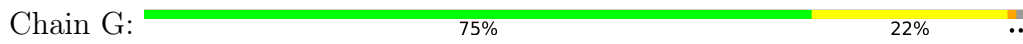


- Molecule 1: Aldehyde dehydrogenase

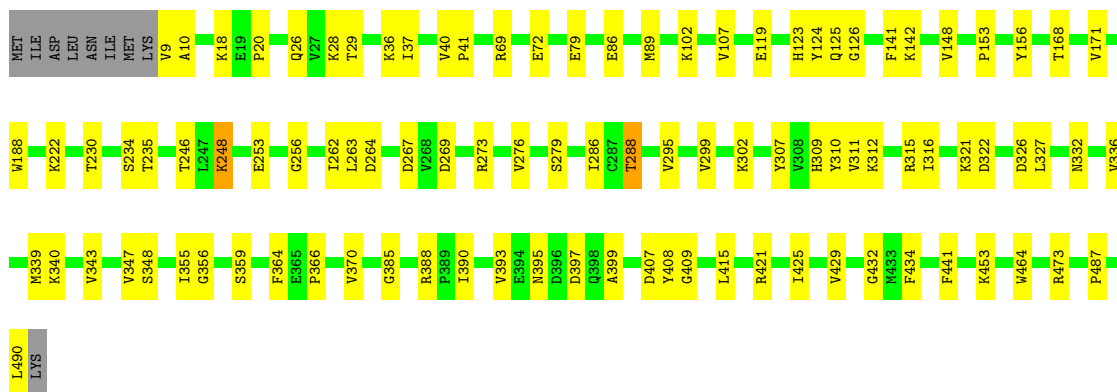
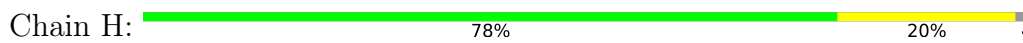
Chain F: 73% 24%



● Molecule 1: Aldehyde dehydrogenase



● Molecule 1: Aldehyde dehydrogenase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	184.24Å 207.23Å 164.96Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	29.77 – 3.04 29.77 – 3.04	Depositor EDS
% Data completeness (in resolution range)	98.9 (29.77-3.04) 98.9 (29.77-3.04)	Depositor EDS
R_{merge}	0.27	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.20 (at 3.06Å)	Xtrriage
Refinement program	PHENIX 1.8.4_1496	Depositor
R, R_{free}	0.202 , 0.256 0.207 , 0.256	Depositor DCC
R_{free} test set	6054 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	43.5	Xtrriage
Anisotropy	0.014	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 33.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	30043	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 46.24 % 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 1.1771e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹Intensities estimated from amplitudes.

²Theoretical 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](#)

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	0.61	0/3839	0.95	6/5208 (0.1%)
1	B	0.60	0/3839	0.98	8/5205 (0.2%)
1	C	0.60	0/3835	0.97	5/5201 (0.1%)
1	D	0.59	0/3825	0.96	5/5188 (0.1%)
1	E	0.59	0/3841	0.98	6/5207 (0.1%)
1	F	0.63	0/3831	1.02	10/5195 (0.2%)
1	G	0.61	0/3839	0.97	6/5205 (0.1%)
1	H	0.60	0/3826	0.95	3/5188 (0.1%)
All	All	0.60	0/30675	0.97	49/41597 (0.1%)

There are no bond length outliers.

The worst 5 of 49 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	285	GLN	N-CA-C	-7.62	104.40	112.93
1	F	484	PHE	CA-C-N	7.41	127.57	119.87
1	F	484	PHE	C-N-CA	7.41	127.57	119.87
1	D	388	ARG	CA-C-N	7.35	127.94	120.14
1	D	388	ARG	C-N-CA	7.35	127.94	120.14

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	3760	0	3753	68	0
1	B	3760	0	3762	71	0
1	C	3756	0	3751	58	0
1	D	3746	0	3742	80	0
1	E	3762	0	3766	74	0
1	F	3752	0	3753	75	0
1	G	3760	0	3762	79	0
1	H	3747	0	3751	62	0
All	All	30043	0	30040	513	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 9.

The worst 5 of 513 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:B:288:THR:HG21	1:B:449:PHE:HZ	1.40	0.85
1:C:69:ARG:HA	1:C:72:GLU:HG3	1.58	0.83
1:C:18:LYS:NZ	1:C:50:GLU:OE1	2.15	0.79
1:C:309:HIS:HA	1:C:312:LYS:HE2	1.65	0.78
1:E:473:ARG:NH2	1:F:426:ALA:O	2.16	0.78

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	483/491 (98%)	471 (98%)	12 (2%)	0	100	100
1	B	482/491 (98%)	472 (98%)	10 (2%)	0	100	100
1	C	482/491 (98%)	469 (97%)	13 (3%)	0	100	100
1	D	481/491 (98%)	468 (97%)	13 (3%)	0	100	100

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	E	482/491 (98%)	472 (98%)	10 (2%)	0	100	100
1	F	481/491 (98%)	468 (97%)	13 (3%)	0	100	100
1	G	482/491 (98%)	468 (97%)	14 (3%)	0	100	100
1	H	480/491 (98%)	467 (97%)	13 (3%)	0	100	100
All	All	3853/3928 (98%)	3755 (98%)	98 (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	396/408 (97%)	386 (98%)	10 (2%)	42	69
1	B	397/408 (97%)	391 (98%)	6 (2%)	57	77
1	C	396/408 (97%)	383 (97%)	13 (3%)	33	64
1	D	394/408 (97%)	377 (96%)	17 (4%)	26	57
1	E	397/408 (97%)	386 (97%)	11 (3%)	38	67
1	F	396/408 (97%)	378 (96%)	18 (4%)	24	56
1	G	397/408 (97%)	386 (97%)	11 (3%)	38	67
1	H	396/408 (97%)	382 (96%)	14 (4%)	32	62
All	All	3169/3264 (97%)	3069 (97%)	100 (3%)	34	64

5 of 100 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	16	GLU
1	F	365	GLU
1	H	359	SER
1	F	76	LYS
1	F	234	SER

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	420	ASN
1	H	285	GLN
1	D	285	GLN
1	E	14	ASN
1	E	26	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](#)

There are no ligands in this entry.

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	485/491 (98%)	-0.32	2 (0%) 88 76	18, 31, 49, 81	0
1	B	484/491 (98%)	-0.30	0 100 100	18, 34, 49, 65	0
1	C	484/491 (98%)	-0.22	1 (0%) 91 83	17, 34, 53, 69	0
1	D	483/491 (98%)	-0.21	1 (0%) 91 83	21, 35, 57, 72	0
1	E	484/491 (98%)	-0.17	3 (0%) 85 69	20, 36, 55, 86	0
1	F	483/491 (98%)	-0.27	1 (0%) 91 83	18, 34, 50, 65	0
1	G	484/491 (98%)	-0.27	1 (0%) 91 83	18, 33, 51, 70	0
1	H	482/491 (98%)	-0.34	0 100 100	19, 31, 49, 64	0
All	All	3869/3928 (98%)	-0.26	9 (0%) 91 83	17, 33, 52, 86	0

The worst 5 of 9 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	7	MET	4.8
1	G	490	LEU	3.1
1	C	490	LEU	3.1
1	A	6	ILE	2.9
1	A	427	GLU	2.4

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

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.