



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 4, 2026 – 08:32 PM UTC

PDB ID : 2ONN / pdb_00002onn
Title : Arg475Gln Mutant of Human Mitochondrial Aldehyde Dehydrogenase, Apo form
Authors : Larson, H.N.; Hurley, T.D.
Deposited on : 2007-01-24
Resolution : 2.75 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

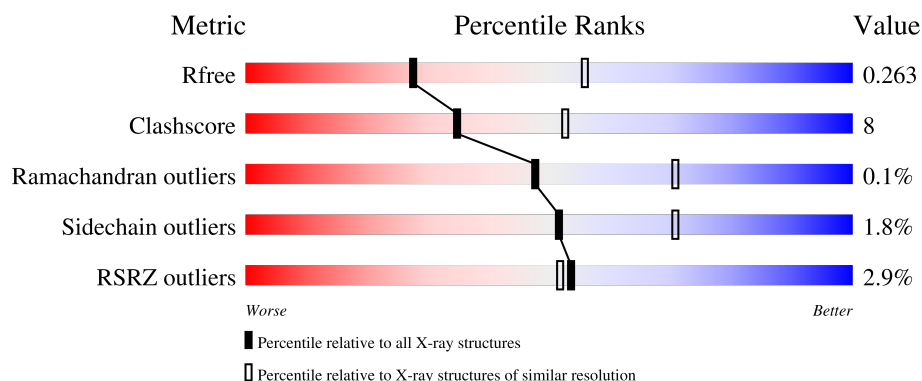
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.75 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	1009 (2.76-2.76)
Clashscore	190562	1044 (2.76-2.76)
Ramachandran outliers	187476	1024 (2.76-2.76)
Sidechain outliers	187428	1024 (2.76-2.76)
RSRZ outliers	180081	1009 (2.76-2.76)

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	500	5% 79% 19% ..
1	B	500	3% 79% 19% ..
1	C	500	2% 81% 16% ..
1	D	500	3% 79% 18% ..
1	E	500	% 81% 17% ..

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Mol	Chain	Length	Quality of chain
1	F	500	% 82% 16% ..
1	G	500	2% 81% 16% ..
1	H	500	6% 82% 16% ..

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 31105 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
1	A	494	Total	C	N	O	S	0	0	0
			3796	2414	646	718	18			
1	B	494	Total	C	N	O	S	0	0	0
			3796	2414	646	718	18			
1	C	494	Total	C	N	O	S	0	0	0
			3796	2414	646	718	18			
1	D	494	Total	C	N	O	S	0	0	0
			3796	2414	646	718	18			
1	E	494	Total	C	N	O	S	0	0	0
			3796	2414	646	718	18			
1	F	494	Total	C	N	O	S	0	0	0
			3796	2414	646	718	18			
1	G	494	Total	C	N	O	S	0	0	0
			3796	2414	646	718	18			
1	H	494	Total	C	N	O	S	0	0	0
			3796	2414	646	718	18			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	475	GLN	ARG	engineered mutation	UNP P05091
B	475	GLN	ARG	engineered mutation	UNP P05091
C	475	GLN	ARG	engineered mutation	UNP P05091
D	475	GLN	ARG	engineered mutation	UNP P05091
E	475	GLN	ARG	engineered mutation	UNP P05091
F	475	GLN	ARG	engineered mutation	UNP P05091
G	475	GLN	ARG	engineered mutation	UNP P05091
H	475	GLN	ARG	engineered mutation	UNP P05091

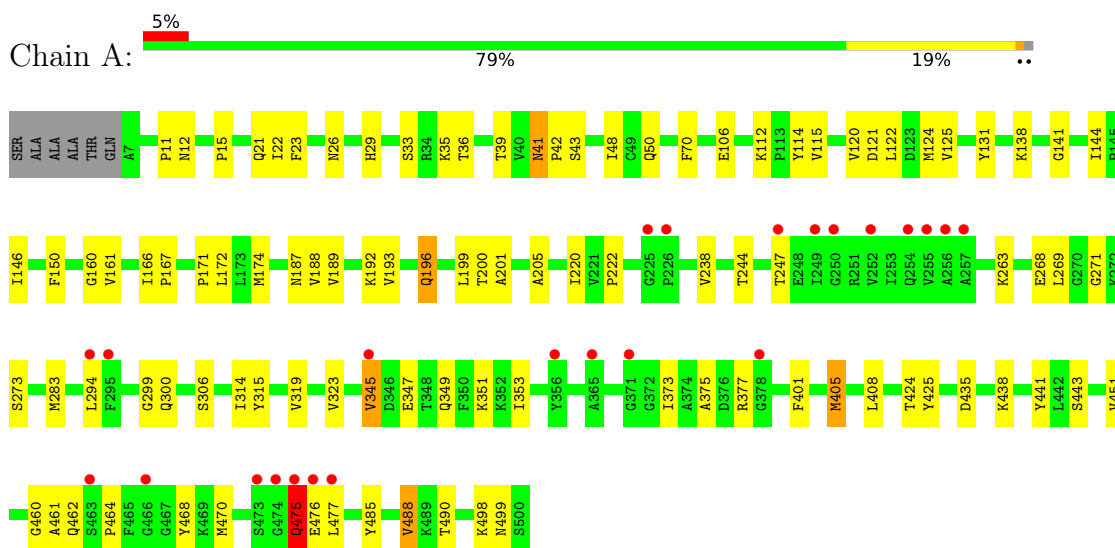
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	73	Total 73	O 73	0	0
2	B	89	Total 89	O 89	0	0
2	C	104	Total 104	O 104	0	0
2	D	82	Total 82	O 82	0	0
2	E	93	Total 93	O 93	0	0
2	F	110	Total 110	O 110	0	0
2	G	101	Total 101	O 101	0	0
2	H	85	Total 85	O 85	0	0

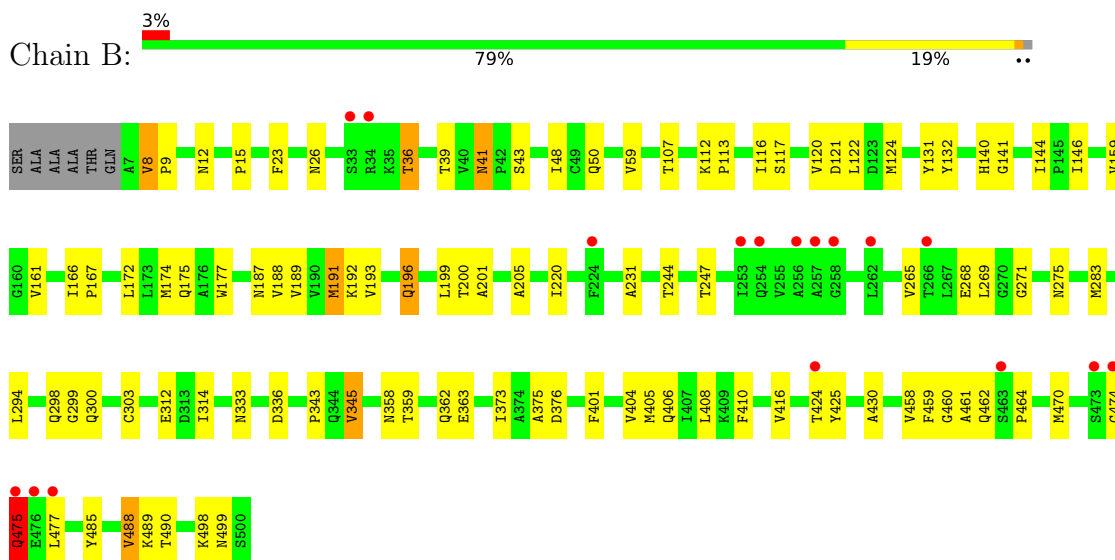
3 Residue-property plots

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.

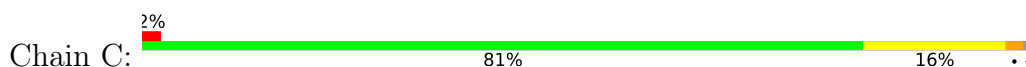
- Molecule 1: Aldehyde dehydrogenase

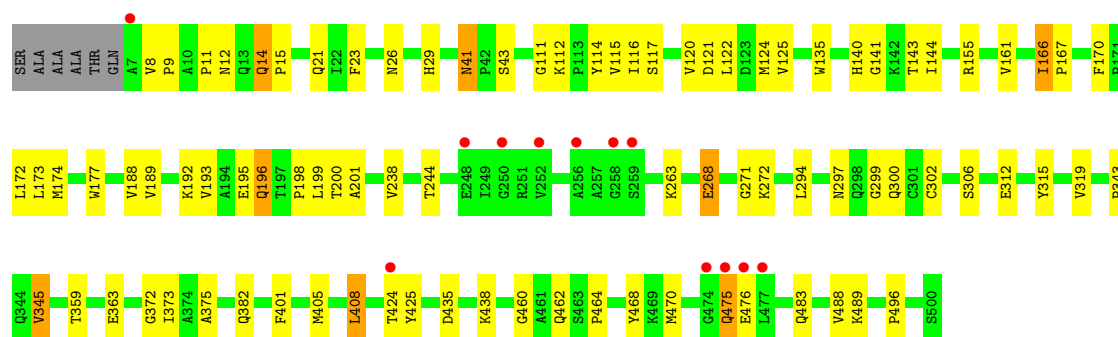


- Molecule 1: Aldehyde dehydrogenase

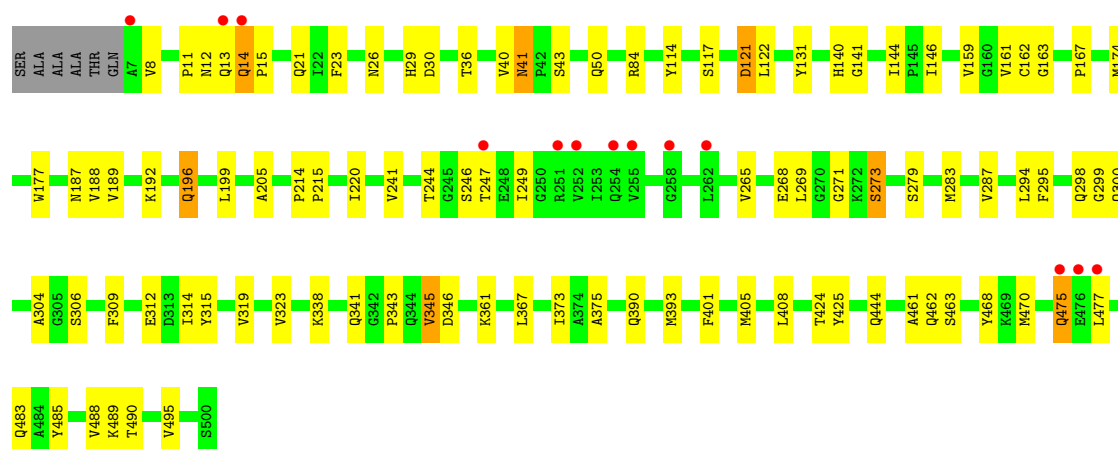
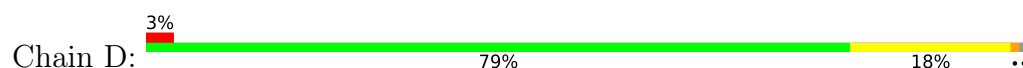


- Molecule 1: Aldehyde dehydrogenase

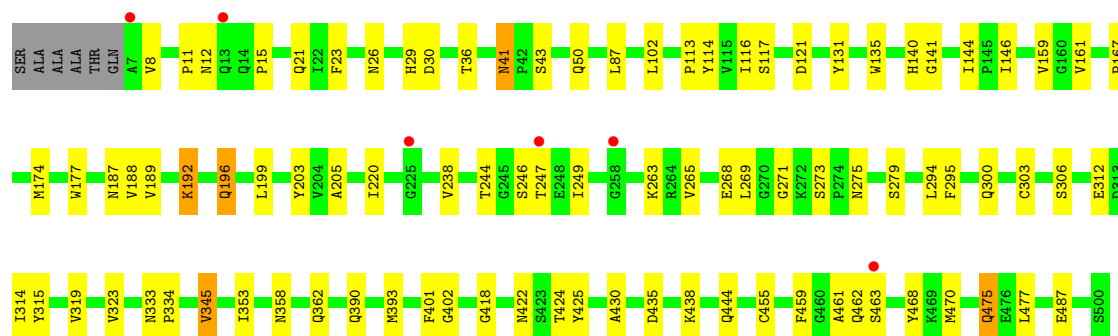
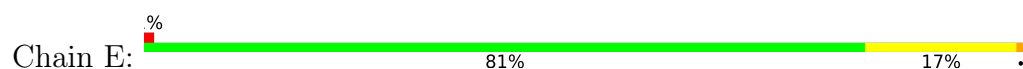




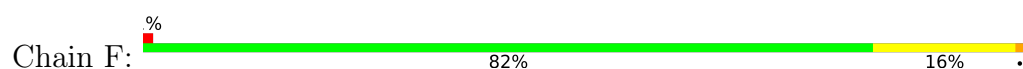
• Molecule 1: Aldehyde dehydrogenase

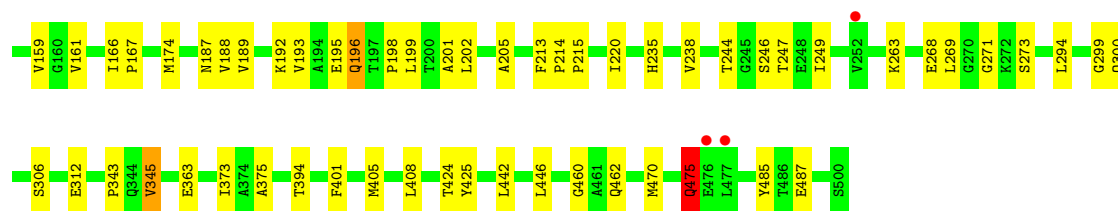


• Molecule 1: Aldehyde dehydrogenase

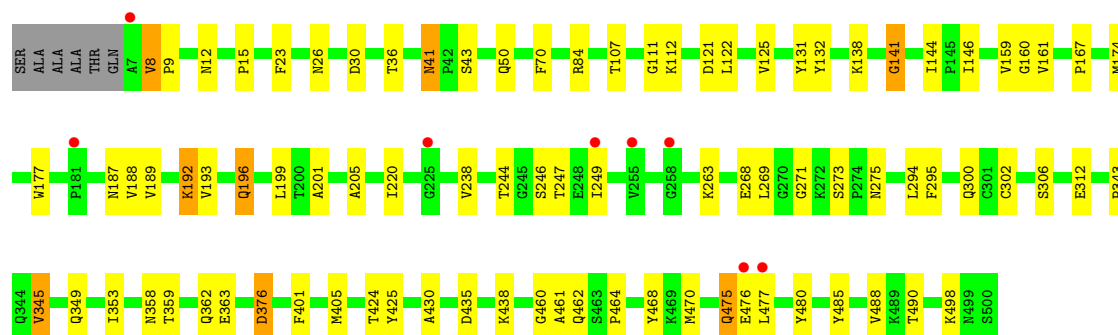
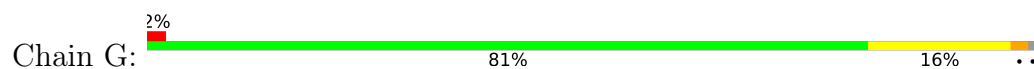


• Molecule 1: Aldehyde dehydrogenase

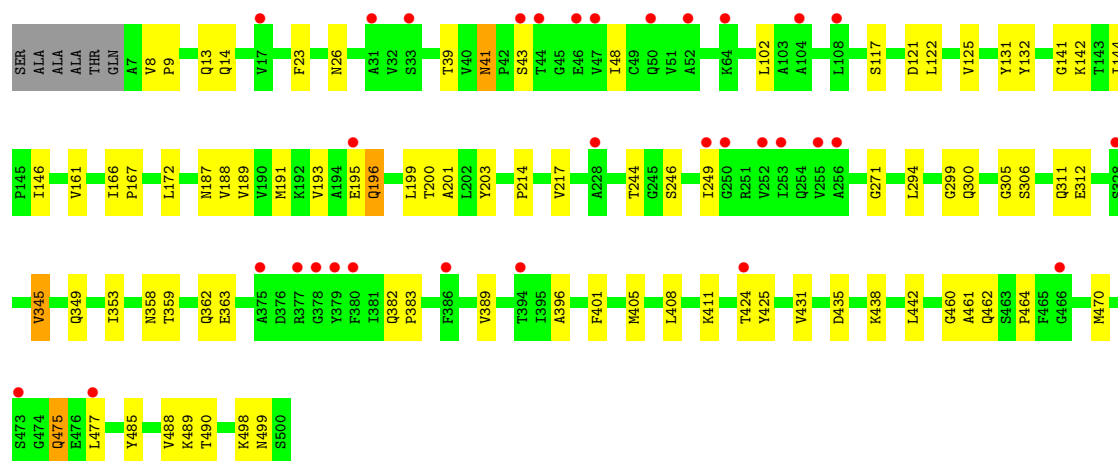
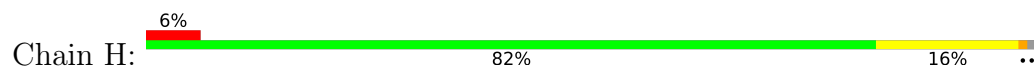




● Molecule 1: Aldehyde dehydrogenase



● Molecule 1: Aldehyde dehydrogenase



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	140.78Å 150.86Å 177.23Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.50 – 2.75 37.50 – 2.75	Depositor EDS
% Data completeness (in resolution range)	96.6 (37.50-2.75) 96.6 (37.50-2.75)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.79 (at 2.77Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.226 , 0.268 0.223 , 0.263	Depositor DCC
R_{free} test set	4801 reflections (1.89%)	wwPDB-VP
Wilson B-factor (Å ²)	32.9	Xtrriage
Anisotropy	0.591	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 32.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	31105	wwPDB-VP
Average B, all atoms (Å ²)	31.0	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 76.16 % 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 1.0993e-06. 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	0.51	2/3880 (0.1%)	0.96	8/5265 (0.2%)
1	B	0.51	1/3880 (0.0%)	0.97	12/5265 (0.2%)
1	C	0.55	1/3880 (0.0%)	0.96	14/5265 (0.3%)
1	D	0.47	1/3880 (0.0%)	0.96	17/5265 (0.3%)
1	E	0.47	0/3880	0.95	13/5265 (0.2%)
1	F	0.52	0/3880	0.96	12/5265 (0.2%)
1	G	0.50	0/3880	0.96	13/5265 (0.2%)
1	H	0.49	0/3880	0.97	9/5265 (0.2%)
All	All	0.50	5/31040 (0.0%)	0.96	98/42120 (0.2%)

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	476	GLU	CD-OE1	-9.80	1.06	1.25
1	A	405	MET	SD-CE	-7.83	1.59	1.79
1	B	36	THR	CA-CB	5.57	1.61	1.53
1	D	341	GLN	CD-OE1	5.47	1.33	1.23
1	A	377	ARG	CZ-NH2	-5.03	1.26	1.33

The worst 5 of 98 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	144	ILE	N-CA-C	9.08	118.77	108.05
1	A	199	LEU	N-CA-C	9.03	120.81	110.97
1	G	199	LEU	N-CA-C	8.79	120.48	111.07
1	H	144	ILE	N-CA-C	8.51	118.10	108.05
1	G	345	VAL	N-CA-C	8.38	119.17	110.62

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	A	3796	0	3740	67	0
1	B	3796	0	3740	69	0
1	C	3796	0	3740	62	0
1	D	3796	0	3740	63	0
1	E	3796	0	3740	59	0
1	F	3796	0	3740	54	0
1	G	3796	0	3740	55	0
1	H	3796	0	3740	53	0
2	A	73	0	0	2	0
2	B	89	0	0	0	0
2	C	104	0	0	2	0
2	D	82	0	0	0	0
2	E	93	0	0	1	0
2	F	110	0	0	0	0
2	G	101	0	0	1	0
2	H	85	0	0	0	0
All	All	31105	0	29920	452	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 8.

The worst 5 of 452 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:E:424:THR:CG2	1:E:470:MET:HE3	1.69	1.21
1:E:424:THR:HG23	1:E:470:MET:HE3	1.21	1.10
1:D:424:THR:HG23	1:D:470:MET:HE3	1.34	1.09
1:F:424:THR:HG23	1:F:470:MET:HE3	1.30	1.07
1:D:424:THR:CG2	1:D:470:MET:HE3	1.84	1.07

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	A	492/500 (98%)	470 (96%)	22 (4%)	0	100	100
1	B	492/500 (98%)	468 (95%)	24 (5%)	0	100	100
1	C	492/500 (98%)	469 (95%)	22 (4%)	1 (0%)	43	64
1	D	492/500 (98%)	472 (96%)	20 (4%)	0	100	100
1	E	492/500 (98%)	472 (96%)	20 (4%)	0	100	100
1	F	492/500 (98%)	474 (96%)	17 (4%)	1 (0%)	43	64
1	G	492/500 (98%)	469 (95%)	23 (5%)	0	100	100
1	H	492/500 (98%)	469 (95%)	23 (5%)	0	100	100
All	All	3936/4000 (98%)	3763 (96%)	171 (4%)	2 (0%)	48	71

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	198	PRO
1	F	198	PRO

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	A	399/402 (99%)	393 (98%)	6 (2%)	57	74
1	B	399/402 (99%)	392 (98%)	7 (2%)	51	71
1	C	399/402 (99%)	389 (98%)	10 (2%)	42	64

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	399/402 (99%)	389 (98%)	10 (2%)	42	64
1	E	399/402 (99%)	393 (98%)	6 (2%)	57	74
1	F	399/402 (99%)	393 (98%)	6 (2%)	57	74
1	G	399/402 (99%)	391 (98%)	8 (2%)	48	69
1	H	399/402 (99%)	394 (99%)	5 (1%)	61	76
All	All	3192/3216 (99%)	3134 (98%)	58 (2%)	51	71

5 of 58 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	196	GLN
1	H	196	GLN
1	E	196	GLN
1	H	122	LEU
1	G	302	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 77 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	275	ASN
1	H	41	ASN
1	F	475	GLN
1	G	196	GLN
1	H	275	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

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 ⓘ

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, 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	494/500 (98%)	0.53	24 (4%)	35	34	5, 38, 68, 83	0
1	B	494/500 (98%)	0.19	17 (3%)	48	46	7, 27, 64, 76	0
1	C	494/500 (98%)	-0.17	12 (2%)	59	57	5, 20, 50, 71	0
1	D	494/500 (98%)	0.34	13 (2%)	57	55	6, 35, 62, 76	0
1	E	494/500 (98%)	0.06	6 (1%)	76	76	6, 29, 55, 69	0
1	F	494/500 (98%)	-0.23	3 (0%)	85	86	6, 20, 45, 67	0
1	G	494/500 (98%)	-0.02	8 (1%)	70	69	5, 25, 56, 71	0
1	H	494/500 (98%)	0.64	32 (6%)	25	24	6, 40, 67, 79	0
All	All	3952/4000 (98%)	0.17	115 (2%)	53	52	5, 28, 62, 83	0

The worst 5 of 115 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	255	VAL	5.0
1	B	253	ILE	4.6
1	H	249	ILE	4.0
1	A	477	LEU	3.8
1	B	476	GLU	3.8

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.