



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 05:30 PM UTC

PDB ID : 2GLF / pdb\_00002glf  
Title : Crystal structure of Aminipeptidase (M18 family) from *Thermotoga Maritima*  
Authors : Min, T.; Shapiro, L.; Burley, S.K.; New York SGX Research Center for Structural Genomics (NYSGXRC)  
Deposited on : 2006-04-04  
Resolution : 2.80 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](mailto: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  
Mogul : 2022.3.0, CSD as543be (2022)  
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

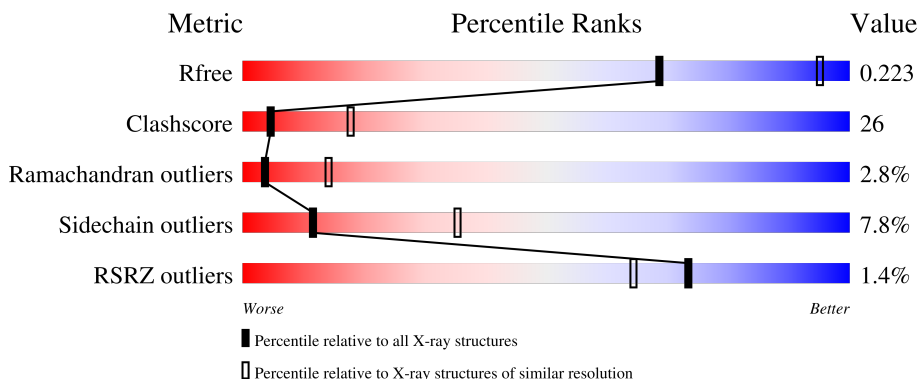
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.80 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	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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	A	450	<div style="display: flex; align-items: center;"> <div style="width: 3%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 50%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 40%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 10%; height: 10px; background-color: orange;"></div> </div> <p style="text-align: center;">3%      50%      40%      10%</p>
1	B	450	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 52%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 39%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 8%; height: 10px; background-color: orange;"></div> </div> <p style="text-align: center;">%      52%      39%      8%</p>
1	C	450	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 54%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 39%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 7%; height: 10px; background-color: orange;"></div> </div> <p style="text-align: center;">%      54%      39%      7%</p>
1	D	450	<div style="display: flex; align-items: center;"> <div style="width: 0%; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="width: 53%; height: 10px; background-color: green; margin-right: 5px;"></div> <div style="width: 37%; height: 10px; background-color: yellow; margin-right: 5px;"></div> <div style="width: 10%; height: 10px; background-color: orange;"></div> </div> <p style="text-align: center;">%      53%      37%      10%</p>

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 14643 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 Probable M18-family aminopeptidase 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	450	3539	2260	596	668	2	13	0	0	0
1	B	450	3539	2260	596	668	2	13	0	0	0
1	C	450	3539	2260	596	668	2	13	0	0	0
1	D	450	3539	2260	596	668	2	13	0	0	0

There are 52 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	4	MSE	MET	modified residue	UNP Q9WYJ9
A	26	MSE	MET	modified residue	UNP Q9WYJ9
A	29	MSE	MET	modified residue	UNP Q9WYJ9
A	37	MSE	MET	modified residue	UNP Q9WYJ9
A	62	MSE	MET	modified residue	UNP Q9WYJ9
A	64	MSE	MET	modified residue	UNP Q9WYJ9
A	187	MSE	MET	modified residue	UNP Q9WYJ9
A	214	MSE	MET	modified residue	UNP Q9WYJ9
A	240	MSE	MET	modified residue	UNP Q9WYJ9
A	305	MSE	MET	modified residue	UNP Q9WYJ9
A	419	MSE	MET	modified residue	UNP Q9WYJ9
A	426	MSE	MET	modified residue	UNP Q9WYJ9
A	449	MSE	MET	modified residue	UNP Q9WYJ9
B	4	MSE	MET	modified residue	UNP Q9WYJ9
B	26	MSE	MET	modified residue	UNP Q9WYJ9
B	29	MSE	MET	modified residue	UNP Q9WYJ9
B	37	MSE	MET	modified residue	UNP Q9WYJ9
B	62	MSE	MET	modified residue	UNP Q9WYJ9
B	64	MSE	MET	modified residue	UNP Q9WYJ9
B	187	MSE	MET	modified residue	UNP Q9WYJ9
B	214	MSE	MET	modified residue	UNP Q9WYJ9

*Continued on next page...*

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
B	240	MSE	MET	modified residue	UNP Q9WYJ9
B	305	MSE	MET	modified residue	UNP Q9WYJ9
B	419	MSE	MET	modified residue	UNP Q9WYJ9
B	426	MSE	MET	modified residue	UNP Q9WYJ9
B	449	MSE	MET	modified residue	UNP Q9WYJ9
C	4	MSE	MET	modified residue	UNP Q9WYJ9
C	26	MSE	MET	modified residue	UNP Q9WYJ9
C	29	MSE	MET	modified residue	UNP Q9WYJ9
C	37	MSE	MET	modified residue	UNP Q9WYJ9
C	62	MSE	MET	modified residue	UNP Q9WYJ9
C	64	MSE	MET	modified residue	UNP Q9WYJ9
C	187	MSE	MET	modified residue	UNP Q9WYJ9
C	214	MSE	MET	modified residue	UNP Q9WYJ9
C	240	MSE	MET	modified residue	UNP Q9WYJ9
C	305	MSE	MET	modified residue	UNP Q9WYJ9
C	419	MSE	MET	modified residue	UNP Q9WYJ9
C	426	MSE	MET	modified residue	UNP Q9WYJ9
C	449	MSE	MET	modified residue	UNP Q9WYJ9
D	4	MSE	MET	modified residue	UNP Q9WYJ9
D	26	MSE	MET	modified residue	UNP Q9WYJ9
D	29	MSE	MET	modified residue	UNP Q9WYJ9
D	37	MSE	MET	modified residue	UNP Q9WYJ9
D	62	MSE	MET	modified residue	UNP Q9WYJ9
D	64	MSE	MET	modified residue	UNP Q9WYJ9
D	187	MSE	MET	modified residue	UNP Q9WYJ9
D	214	MSE	MET	modified residue	UNP Q9WYJ9
D	240	MSE	MET	modified residue	UNP Q9WYJ9
D	305	MSE	MET	modified residue	UNP Q9WYJ9
D	419	MSE	MET	modified residue	UNP Q9WYJ9
D	426	MSE	MET	modified residue	UNP Q9WYJ9
D	449	MSE	MET	modified residue	UNP Q9WYJ9

- Molecule 2 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn).

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

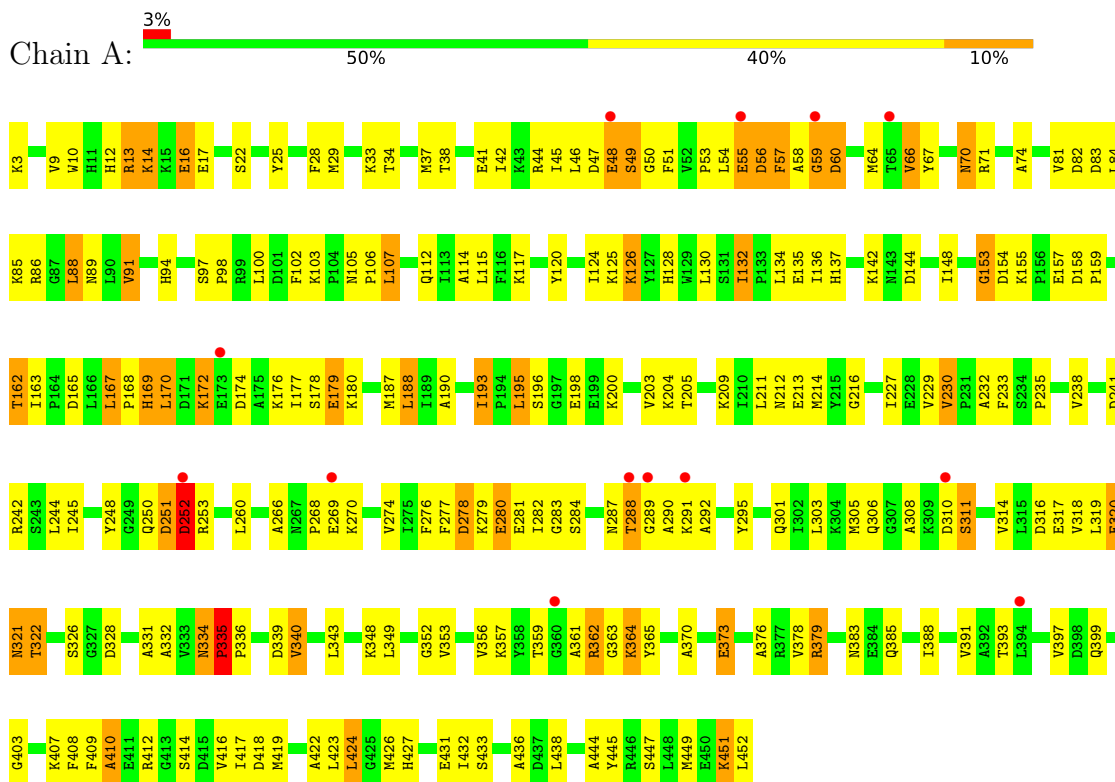
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	121	Total 121	O 121	0	0
3	B	117	Total 117	O 117	0	0
3	C	127	Total 127	O 127	0	0
3	D	114	Total 114	O 114	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: Probable M18-family aminopeptidase 1

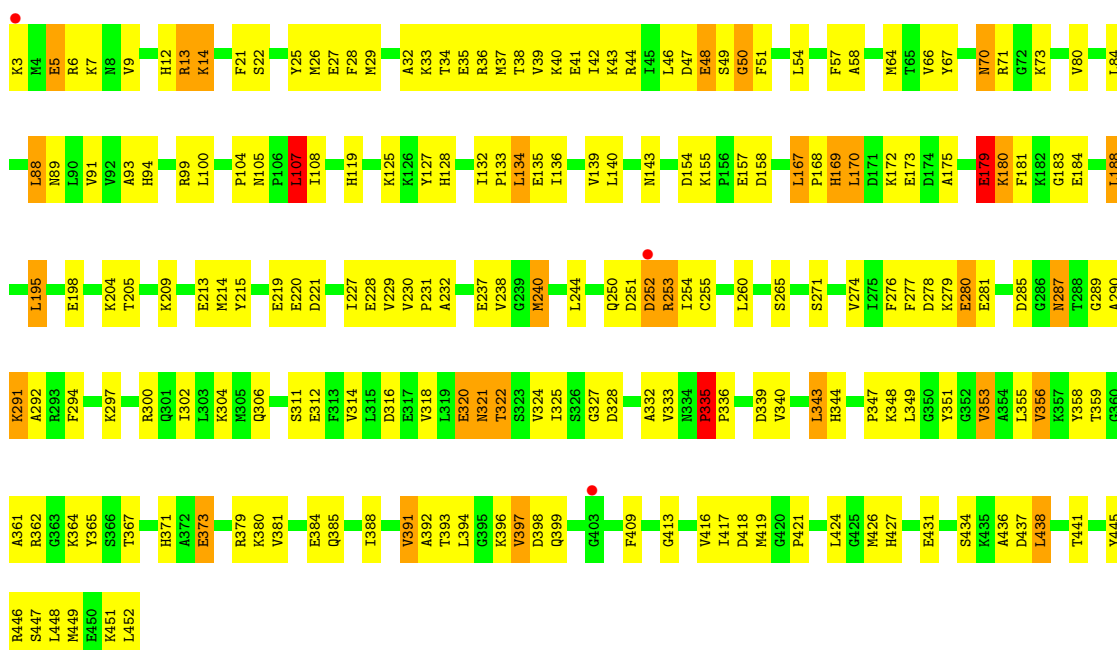


- Molecule 1: Probable M18-family aminopeptidase 1

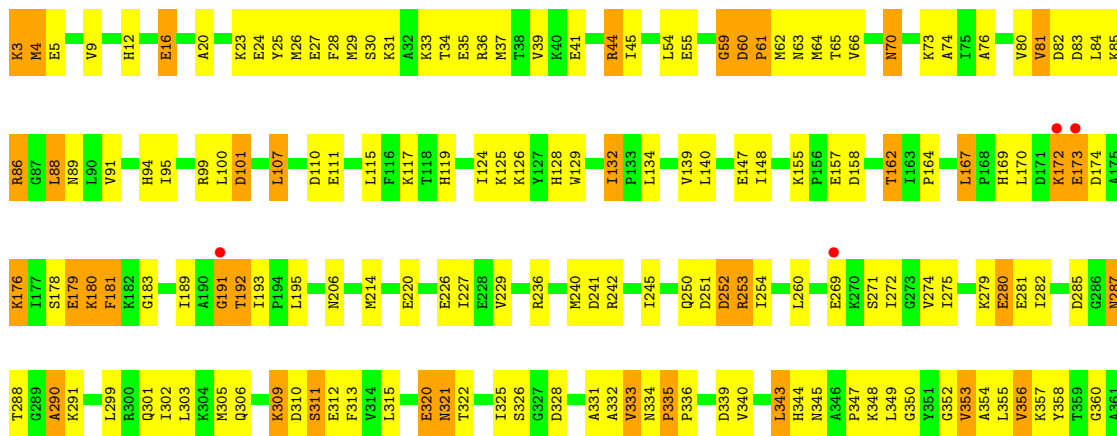




● Molecule 1: Probable M18-family aminopeptidase 1



● Molecule 1: Probable M18-family aminopeptidase 1





## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 3	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	191.22Å 191.22Å 191.22Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.83 – 2.80 19.83 – 2.80	Depositor EDS
% Data completeness (in resolution range)	88.8 (19.83-2.80) 97.1 (19.83-2.80)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.61 (at 2.79Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.168 , 0.239 0.160 , 0.223	Depositor DCC
$R_{free}$ test set	3372 reflections (3.05%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	27.0	Xtrriage
Anisotropy	0.000	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 46.9	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.013 for l,-k,h	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	14643	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	22.0	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 36.21 % 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 5.1798e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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: 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	0.41	0/3598	0.97	15/4829 (0.3%)
1	B	0.41	0/3598	1.01	22/4829 (0.5%)
1	C	0.42	0/3598	0.98	14/4829 (0.3%)
1	D	0.42	0/3598	0.98	15/4829 (0.3%)
All	All	0.42	0/14392	0.99	66/19316 (0.3%)

There are no bond length outliers.

The worst 5 of 66 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	48	GLU	N-CA-C	-10.61	97.04	110.19
1	B	253	ARG	N-CA-C	-9.84	100.41	111.82
1	A	253	ARG	N-CA-C	-8.23	102.69	112.89
1	B	321	ASN	N-CA-C	-7.83	97.73	109.86
1	A	269	GLU	N-CA-C	-7.52	103.67	114.12

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	3539	0	3545	220	0
1	B	3539	0	3545	184	0

*Continued on next page...*

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	3539	0	3545	184	0
1	D	3539	0	3545	212	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
2	C	2	0	0	0	0
2	D	2	0	0	0	0
3	A	121	0	0	9	0
3	B	117	0	0	13	0
3	C	127	0	0	12	0
3	D	114	0	0	12	0
All	All	14643	0	14180	738	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 26.

The worst 5 of 738 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:D:29:MSE:HE1	1:D:253:ARG:HB3	1.50	0.92
1:B:94:HIS:CG	1:B:280:GLU:HG2	2.08	0.87
1:A:13:ARG:O	1:A:14:LYS:HB3	1.75	0.86
1:D:100:LEU:HB2	1:D:229:VAL:HB	1.56	0.86
1:B:372:ALA:HB2	1:D:226:GLU:HG3	1.57	0.86

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	448/450 (100%)	395 (88%)	40 (9%)	13 (3%)	3	13
1	B	448/450 (100%)	409 (91%)	28 (6%)	11 (2%)	4	16

Continued on next page...

Continued from previous page...

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	448/450 (100%)	405 (90%)	33 (7%)	10 (2%)	5	19
1	D	448/450 (100%)	401 (90%)	31 (7%)	16 (4%)	2	10
All	All	1792/1800 (100%)	1610 (90%)	132 (7%)	50 (3%)	4	14

5 of 50 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	126	LYS
1	A	362	ARG
1	B	157	GLU
1	B	328	ASP
1	B	361	ALA

### 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	378/365 (104%)	344 (91%)	34 (9%)	9	28
1	B	378/365 (104%)	349 (92%)	29 (8%)	12	36
1	C	378/365 (104%)	353 (93%)	25 (7%)	15	43
1	D	378/365 (104%)	348 (92%)	30 (8%)	11	35
All	All	1512/1460 (104%)	1394 (92%)	118 (8%)	11	35

5 of 118 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	348	LYS
1	D	343	LEU
1	C	179	GLU
1	D	333	VAL
1	D	167	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 41 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	399	GLN
1	D	287	ASN
1	D	11	HIS
1	D	169	HIS
1	D	306	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](#)

Of 8 ligands modelled in this entry, 8 are monoatomic - leaving 0 for Mogul analysis.

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 [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, 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	A	437/450 (97%)	-0.23	13 (2%) 52 42	7, 21, 51, 100	0
1	B	437/450 (97%)	-0.34	4 (0%) 81 74	3, 18, 44, 77	0
1	C	437/450 (97%)	-0.38	3 (0%) 84 77	4, 17, 43, 89	0
1	D	437/450 (97%)	-0.31	5 (1%) 78 70	3, 19, 46, 85	0
All	All	1748/1800 (97%)	-0.32	25 (1%) 73 64	3, 19, 45, 100	0

The worst 5 of 25 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	291	LYS	3.6
1	A	252	ASP	3.5
1	C	252	ASP	3.2
1	B	327	GLY	3.0
1	C	3	LYS	3.0

### 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
2	MN	A	5002	1/1	0.97	0.05	19,19,19,19	0
2	MN	A	5001	1/1	0.99	0.04	17,17,17,17	0
2	MN	B	5003	1/1	0.99	0.03	18,18,18,18	0
2	MN	B	5004	1/1	0.99	0.02	17,17,17,17	0
2	MN	C	5006	1/1	0.99	0.03	15,15,15,15	0
2	MN	C	5007	1/1	0.99	0.05	17,17,17,17	0
2	MN	D	5008	1/1	0.99	0.02	16,16,16,16	0
2	MN	D	5009	1/1	0.99	0.02	18,18,18,18	0

## 6.5 Other polymers [\(i\)](#)

There are no such residues in this entry.