



# wwPDB X-ray Structure Validation Summary Report i

Feb 27, 2014 – 02:50 PM GMT

PDB ID : 3AX3  
Title : Crystal structure of rat TOM20-ALDH presequence complex: a complex (form2) between Tom20 and a disulfide-bridged presequence peptide containing D-Cys and L-Cys at the i and i+3 positions.  
Authors : Saitoh, T.; Maita, Y.; Kohda, D.  
Deposited on : 2011-03-28  
Resolution : 2.10 Å(reported)

This is a wwPDB 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 <http://wwpdb.org/ValidationPDFNotes.html>

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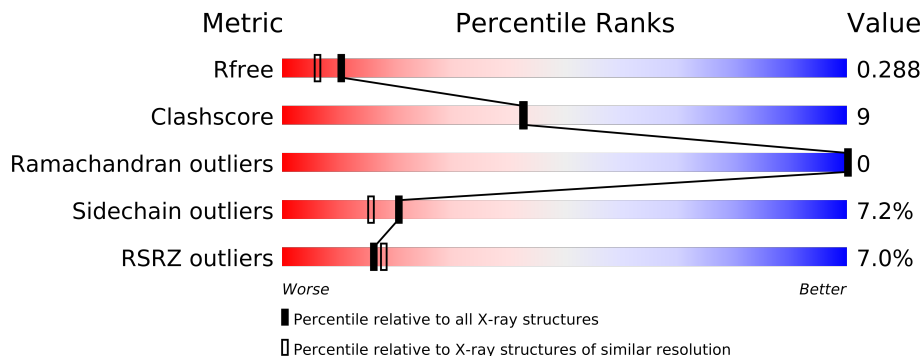
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.15 2013  
Xtriage (Phenix) : dev-1323  
EDS : stable22639  
Percentile statistics : 21963  
Refmac : 5.8.0049  
CCP4 : 6.3.0 (Settle)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : stable22683

# 1 Overall quality at a glance

The reported resolution of this entry is 2.10 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))
$R_{free}$	66092	3012 (2.10-2.10)
Clashscore	79885	3649 (2.10-2.10)
Ramachandran outliers	78287	3610 (2.10-2.10)
Sidechain outliers	78261	3611 (2.10-2.10)
RSRZ outliers	66119	3013 (2.10-2.10)

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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	73	
1	C	73	
1	E	73	
1	G	73	
2	B	12	
2	D	12	
2	F	12	
2	H	12	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2488 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Mitochondrial import receptor subunit TOM20 homolog.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	66	Total	C	N	O	S	0	0	0
			519	334	83	101	1			
1	C	66	Total	C	N	O	S	0	0	0
			519	334	83	101	1			
1	E	68	Total	C	N	O	S	0	0	0
			535	344	85	105	1			
1	G	68	Total	C	N	O	S	0	0	0
			535	344	85	105	1			

There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	54	GLY	-	EXPRESSION TAG	UNP Q62760
A	55	PRO	-	EXPRESSION TAG	UNP Q62760
A	56	LEU	-	EXPRESSION TAG	UNP Q62760
A	57	GLY	-	EXPRESSION TAG	UNP Q62760
A	58	SER	-	EXPRESSION TAG	UNP Q62760
A	100	SER	CYS	ENGINEERED MUTATION	UNP Q62760
C	54	GLY	-	EXPRESSION TAG	UNP Q62760
C	55	PRO	-	EXPRESSION TAG	UNP Q62760
C	56	LEU	-	EXPRESSION TAG	UNP Q62760
C	57	GLY	-	EXPRESSION TAG	UNP Q62760
C	58	SER	-	EXPRESSION TAG	UNP Q62760
C	100	SER	CYS	ENGINEERED MUTATION	UNP Q62760
E	54	GLY	-	EXPRESSION TAG	UNP Q62760
E	55	PRO	-	EXPRESSION TAG	UNP Q62760
E	56	LEU	-	EXPRESSION TAG	UNP Q62760
E	57	GLY	-	EXPRESSION TAG	UNP Q62760
E	58	SER	-	EXPRESSION TAG	UNP Q62760
E	100	SER	CYS	ENGINEERED MUTATION	UNP Q62760
G	54	GLY	-	EXPRESSION TAG	UNP Q62760
G	55	PRO	-	EXPRESSION TAG	UNP Q62760
G	56	LEU	-	EXPRESSION TAG	UNP Q62760

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Chain	Residue	Modelled	Actual	Comment	Reference
G	57	GLY	-	EXPRESSION TAG	UNP Q62760
G	58	SER	-	EXPRESSION TAG	UNP Q62760
G	100	SER	CYS	ENGINEERED MUTATION	UNP Q62760

- Molecule 2 is a protein called Aldehyde dehydrogenase, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	12	Total	C	N	O	S	0	0	1
			86	53	18	13	2			
2	D	12	Total	C	N	O	S	0	0	1
			86	53	18	13	2			
2	F	12	Total	C	N	O	S	0	0	1
			86	53	18	13	2			
2	H	12	Total	C	N	O	S	0	0	1
			86	53	18	13	2			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	13	DCY	PRO	ENGINEERED MUTATION	UNP P11884
B	16	CYS	SER	ENGINEERED MUTATION	UNP P11884
B	21	TYR	-	EXPRESSION TAG	UNP P11884
B	22	ALA	-	EXPRESSION TAG	UNP P11884
B	23	NH2	-	AMIDATION	UNP P11884
D	13	DCY	PRO	ENGINEERED MUTATION	UNP P11884
D	16	CYS	SER	ENGINEERED MUTATION	UNP P11884
D	21	TYR	-	EXPRESSION TAG	UNP P11884
D	22	ALA	-	EXPRESSION TAG	UNP P11884
D	23	NH2	-	AMIDATION	UNP P11884
F	13	DCY	PRO	ENGINEERED MUTATION	UNP P11884
F	16	CYS	SER	ENGINEERED MUTATION	UNP P11884
F	21	TYR	-	EXPRESSION TAG	UNP P11884
F	22	ALA	-	EXPRESSION TAG	UNP P11884
F	23	NH2	-	AMIDATION	UNP P11884
H	13	DCY	PRO	ENGINEERED MUTATION	UNP P11884
H	16	CYS	SER	ENGINEERED MUTATION	UNP P11884
H	21	TYR	-	EXPRESSION TAG	UNP P11884
H	22	ALA	-	EXPRESSION TAG	UNP P11884
H	23	NH2	-	AMIDATION	UNP P11884

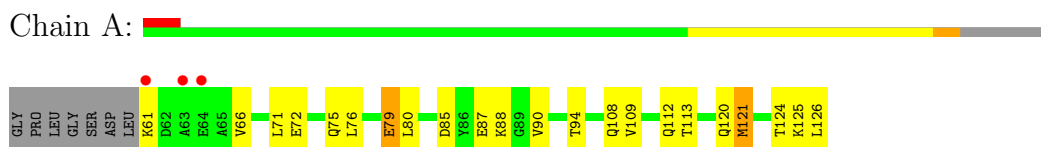
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	6	Total 6	O 6	0	0
3	C	10	Total 10	O 10	0	0
3	E	13	Total 13	O 13	0	0
3	F	2	Total 2	O 2	0	0
3	G	3	Total 3	O 3	0	0
3	H	2	Total 2	O 2	0	0

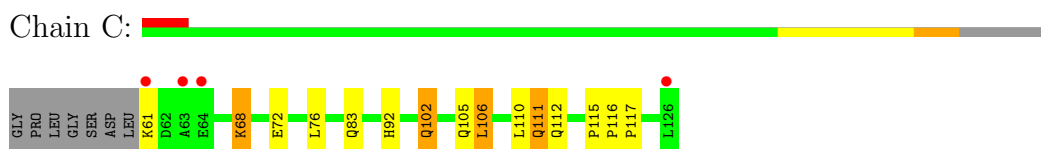
### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

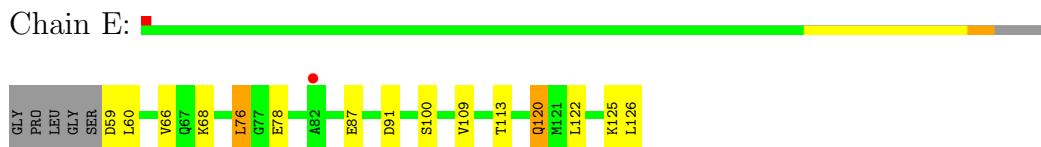
- Molecule 1: Mitochondrial import receptor subunit TOM20 homolog



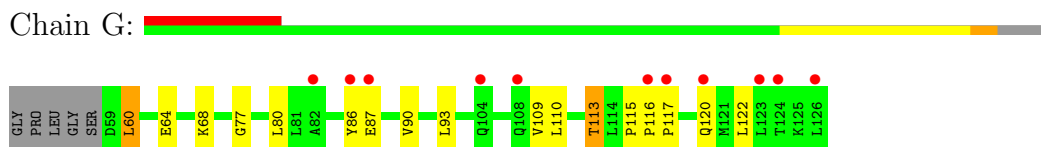
- Molecule 1: Mitochondrial import receptor subunit TOM20 homolog



- Molecule 1: Mitochondrial import receptor subunit TOM20 homolog



- Molecule 1: Mitochondrial import receptor subunit TOM20 homolog



- Molecule 2: Aldehyde dehydrogenase, mitochondrial



- Molecule 2: Aldehyde dehydrogenase, mitochondrial



- Molecule 2: Aldehyde dehydrogenase, mitochondrial

Chain F: 



- Molecule 2: Aldehyde dehydrogenase, mitochondrial

Chain H: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	99.60Å 99.60Å 195.18Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	28.94 – 2.10 28.94 – 2.10	Depositor EDS
% Data completeness (in resolution range)	99.1 (28.94-2.10) 99.1 (28.94-2.10)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.78 (at 2.10Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, $R_{free}$	0.243 , 0.287 0.244 , 0.288	Depositor DCC
$R_{free}$ test set	1127 reflections (5.43%)	DCC
Wilson B-factor (Å <sup>2</sup> )	35.0	Xtriage
Anisotropy	0.109	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.41 , 50.6	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 21866 reflections	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	2488	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 44.10 % 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 1.6029e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<sup>1</sup>Intensities estimated from amplitudes.



## 5 Model quality ⓘ

### 5.1 Standard geometry ⓘ

Bond lengths and bond angles in the following residue types are not validated in this section: NH2, DCY

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	1.21	1/527 (0.2%)	0.94	1/713 (0.1%)
1	C	1.01	0/527	0.89	0/713
1	E	1.22	0/543	1.00	1/735 (0.1%)
1	G	0.94	0/543	0.88	1/735 (0.1%)
2	B	1.04	0/78	0.97	0/101
2	D	1.04	0/78	0.95	0/101
2	F	1.35	0/78	1.20	0/101
2	H	0.96	0/78	1.02	0/101
All	All	1.10	1/2452 (0.0%)	0.95	3/3300 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	79	GLU	CG-CD	5.48	1.60	1.51

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	76	LEU	CA-CB-CG	5.81	128.67	115.30
1	A	121	MET	CG-SD-CE	5.24	108.58	100.20
1	G	60	LEU	CA-CB-CG	5.10	127.03	115.30

There are no chirality outliers.

There are no planarity outliers.

### 5.2 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 hydrogens

added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	519	0	527	12	1
1	C	519	0	527	10	0
1	E	535	0	542	11	0
1	G	535	0	542	12	0
2	B	86	0	87	2	0
2	D	86	0	88	2	0
2	F	86	0	86	1	0
2	H	86	0	87	1	0
3	A	6	0	0	0	0
3	C	10	0	0	1	0
3	E	13	0	0	2	0
3	F	2	0	0	0	0
3	G	3	0	0	0	0
3	H	2	0	0	0	0
All	All	2488	0	2486	44	1

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 9.

The worst 5 of 44 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:E:91:ASP:OD1	1:E:125:LYS:HE2	1.27	1.27
1:E:59:ASP:HB2	3:E:8:HOH:O	1.79	0.82
1:A:80:LEU:HD13	1:A:88:LYS:HG2	1.61	0.82
1:G:86:TYR:O	1:G:90:VAL:HG23	1.82	0.80
1:C:111:GLN:NE2	1:C:112:GLN:HE21	1.79	0.80

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:85:ASP:OD2	1:A:125:LYS:NZ[2_565]	2.19	0.01

## 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	64/73 (88%)	64 (100%)	0	0	100	100
1	C	64/73 (88%)	64 (100%)	0	0	100	100
1	E	66/73 (90%)	66 (100%)	0	0	100	100
1	G	66/73 (90%)	64 (97%)	2 (3%)	0	100	100
2	B	9/12 (75%)	9 (100%)	0	0	100	100
2	D	9/12 (75%)	9 (100%)	0	0	100	100
2	F	9/12 (75%)	9 (100%)	0	0	100	100
2	H	9/12 (75%)	9 (100%)	0	0	100	100
All	All	296/340 (87%)	294 (99%)	2 (1%)	0	100	100

There are no Ramachandran outliers to report.

### 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	57/62 (92%)	54 (95%)	3 (5%)	32	28
1	C	57/62 (92%)	51 (90%)	6 (10%)	10	5
1	E	59/62 (95%)	53 (90%)	6 (10%)	11	6
1	G	59/62 (95%)	55 (93%)	4 (7%)	22	18
2	B	8/8 (100%)	8 (100%)	0	100	100
2	D	8/8 (100%)	8 (100%)	0	100	100
2	F	8/8 (100%)	8 (100%)	0	100	100
2	H	8/8 (100%)	8 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	264/280 (94%)	245 (93%)	19 (7%)	21	16

5 of 19 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	111	GLN
1	E	68	LYS
1	G	60	LEU
1	C	106	LEU
1	G	80	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	105	GLN
1	C	111	GLN
1	E	120	GLN

### 5.3.3 RNA ⓘ

There are no RNA chains in this entry.

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

4 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	$\# Z  > 2$
2	DCY	B	13	2	5,5,6	7.56	1 (20%)	3,5,7	2.00	1 (33%)
2	DCY	D	13	2	5,5,6	7.05	1 (20%)	3,5,7	4.18	2 (66%)
2	DCY	F	13	2	5,5,6	7.42	3 (60%)	3,5,7	6.49	1 (33%)
2	DCY	H	13	2	5,5,6	7.67	1 (20%)	3,5,7	4.15	1 (33%)

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
2	DCY	B	13	2	-	0/2/4/6	0/0/0/0
2	DCY	D	13	2	-	0/2/4/6	0/0/0/0
2	DCY	F	13	2	-	0/2/4/6	0/0/0/0
2	DCY	H	13	2	-	0/2/4/6	0/0/0/0

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	H	13	DCY	O-C	16.96	1.23	1.11
2	B	13	DCY	O-C	16.75	1.22	1.11
2	D	13	DCY	O-C	15.57	1.22	1.11
2	F	13	DCY	O-C	15.45	1.22	1.11
2	F	13	DCY	CA-C	5.56	1.59	1.48

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	13	DCY	C-CA-N	11.19	125.01	113.83
2	H	13	DCY	C-CA-N	-7.02	106.82	113.83
2	D	13	DCY	C-CA-N	-6.77	107.07	113.83
2	B	13	DCY	C-CA-N	-3.30	110.53	113.83
2	D	13	DCY	CB-CA-N	2.54	114.24	110.23

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

There are no ligands in this entry.

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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<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	66/73 (90%)	0.50	3 (4%) 32 35	23, 33, 43, 63	0
1	C	66/73 (90%)	0.50	4 (6%) 21 23	27, 38, 55, 67	0
1	E	68/73 (93%)	0.43	1 (1%) 70 74	22, 33, 53, 59	0
1	G	68/73 (93%)	1.06	11 (16%) 2 2	32, 48, 65, 69	0
2	B	12/12 (100%)	0.79	2 (16%) 2 2	41, 51, 56, 56	0
2	D	12/12 (100%)	0.21	1 (8%) 11 12	33, 38, 46, 47	0
2	F	12/12 (100%)	0.54	0 100 100	27, 34, 43, 49	0
2	H	12/12 (100%)	0.39	0 100 100	35, 43, 49, 51	0
All	All	316/340 (92%)	0.60	22 (6%) 16 18	22, 39, 59, 69	0

The worst 5 of 22 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	63	ALA	4.5
1	E	82	ALA	4.5
1	G	82	ALA	4.5
1	C	63	ALA	4.3
1	C	61	LYS	3.7

### 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	RSR	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	DCY	F	13	6/7	0.15	0.70	36,38,40,45	0
2	DCY	D	13	6/7	0.11	-0.89	38,42,43,44	0
2	DCY	B	13	6/7	0.11	-1.28	49,50,51,51	0
2	DCY	H	13	6/7	0.12	-1.42	43,46,48,51	0

### 6.3 Carbohydrates [i](#)

There are no carbohydrates 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.