



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 18, 2025 – 09:42 PM EDT

PDB ID : 3QOR  
Title : Crystal structure of human nuclear migration protein NudC  
Authors : Derewenda, U.; Derewenda, Z.; Zheng, M.  
Deposited on : 2011-02-10  
Resolution : 1.75 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](mailto:validation@mail.wwpdb.org)

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<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>.

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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	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.21
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.004 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.4

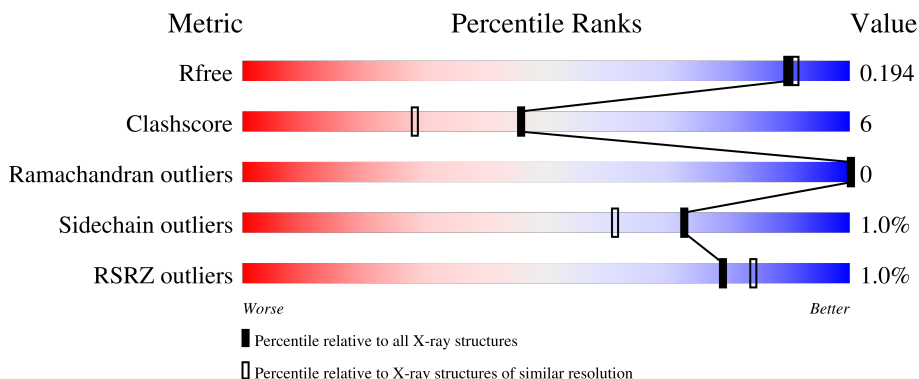
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.75 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))
$R_{free}$	164625	2888 (1.76-1.76)
Clashscore	180529	3097 (1.76-1.76)
Ramachandran outliers	177936	3072 (1.76-1.76)
Sidechain outliers	177891	3072 (1.76-1.76)
RSRZ outliers	164620	2887 (1.76-1.76)

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  $\geq 3$ , 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	121	 2% 88% 10% 2%
2	B	121	 93% 5%
3	C	121	 87% 10%
4	D	121	 81% 16%
4	E	121	 2% 85% 10%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
5	ACT	A	301	-	-	X	-

## 2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 5753 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 Nuclear migration protein nudC.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	120	Total	C	N	O	S	0	8	0
			998	636	173	185	4			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	154	GLY	-	expression tag	UNP Q9Y266
A	155	SER	-	expression tag	UNP Q9Y266
A	156	SER	-	expression tag	UNP Q9Y266
A	157	SER	-	expression tag	UNP Q9Y266
A	236	ALA	GLU	engineered mutation	UNP Q9Y266
A	239	ALA	LYS	engineered mutation	UNP Q9Y266

- Molecule 2 is a protein called Nuclear migration protein nudC.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	119	Total	C	N	O	S	0	6	0
			984	626	170	184	4			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	154	GLY	-	expression tag	UNP Q9Y266
B	155	SER	-	expression tag	UNP Q9Y266
B	156	SER	-	expression tag	UNP Q9Y266
B	157	SER	-	expression tag	UNP Q9Y266
B	236	ALA	GLU	engineered mutation	UNP Q9Y266
B	239	ALA	LYS	engineered mutation	UNP Q9Y266

- Molecule 3 is a protein called Nuclear migration protein nudC.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	117	Total	C	N	O	S	0	2	0
			946	603	164	175	4			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	154	GLY	-	expression tag	UNP Q9Y266
C	155	SER	-	expression tag	UNP Q9Y266
C	156	SER	-	expression tag	UNP Q9Y266
C	157	SER	-	expression tag	UNP Q9Y266
C	236	ALA	GLU	engineered mutation	UNP Q9Y266
C	239	ALA	LYS	engineered mutation	UNP Q9Y266

- Molecule 4 is a protein called Nuclear migration protein nudC.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	117	Total	C	N	O	S	3	7	0
			970	615	165	185	5			
4	E	118	Total	C	N	O	S	0	6	0
			974	620	168	182	4			

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	154	GLY	-	expression tag	UNP Q9Y266
D	155	SER	-	expression tag	UNP Q9Y266
D	156	SER	-	expression tag	UNP Q9Y266
D	157	SER	-	expression tag	UNP Q9Y266
D	236	ALA	GLU	engineered mutation	UNP Q9Y266
D	239	ALA	LYS	engineered mutation	UNP Q9Y266
E	154	GLY	-	expression tag	UNP Q9Y266
E	155	SER	-	expression tag	UNP Q9Y266
E	156	SER	-	expression tag	UNP Q9Y266
E	157	SER	-	expression tag	UNP Q9Y266
E	236	ALA	GLU	engineered mutation	UNP Q9Y266
E	239	ALA	LYS	engineered mutation	UNP Q9Y266

- Molecule 5 is ACETATE ION (three-letter code: ACT) (formula: C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			4	2	2		

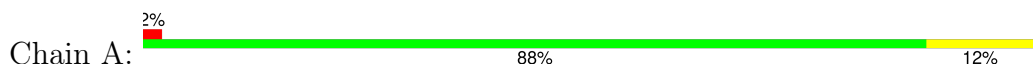
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	187	Total	O	0	0
			187	187		
6	B	192	Total	O	0	0
			192	192		
6	C	236	Total	O	0	0
			236	236		
6	D	176	Total	O	0	0
			176	176		
6	E	86	Total	O	0	0
			86	86		

### 3 Residue-property plots [i](#)

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.

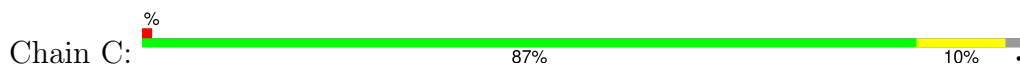
- Molecule 1: Nuclear migration protein nudC



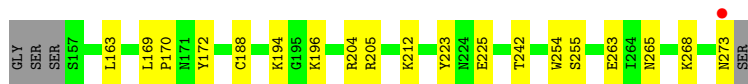
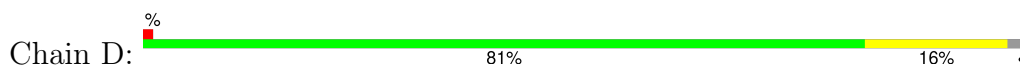
- Molecule 2: Nuclear migration protein nudC



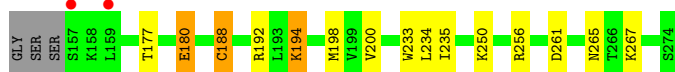
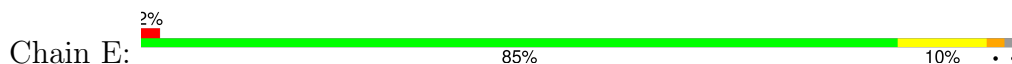
- Molecule 3: Nuclear migration protein nudC



- Molecule 4: Nuclear migration protein nudC



- Molecule 4: Nuclear migration protein nudC



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	66.73Å 51.82Å 92.85Å 90.00° 90.58° 90.00°	Depositor
Resolution (Å)	28.05 – 1.75 28.05 – 1.75	Depositor EDS
% Data completeness (in resolution range)	99.6 (28.05-1.75) 99.7 (28.05-1.75)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.61 (at 1.75Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.6.4_486)	Depositor
R, $R_{free}$	0.173 , 0.202 0.166 , 0.194	Depositor DCC
$R_{free}$ test set	3226 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.8	Xtriage
Anisotropy	0.704	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 44.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.026 for h,-k,-l	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	5753	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	27.0	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 20.86 % 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 7.9372e-03. 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: CSX, ACT, OCS, CSD

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	0.37	0/1033	0.54	0/1397
2	B	0.33	0/1013	0.51	0/1369
3	C	0.36	0/971	0.54	0/1315
4	D	0.34	0/993	0.54	0/1345
4	E	0.25	0/1001	0.44	0/1353
All	All	0.33	0/5011	0.51	0/6779

There are no bond length outliers.

There are no bond angle outliers.

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	998	0	1031	15	0
2	B	984	0	1013	2	0
3	C	946	0	961	20	0
4	D	970	0	990	16	0
4	E	974	0	993	13	0
5	A	4	0	3	3	0
6	A	187	0	0	2	0
6	B	192	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	C	236	0	0	8	0
6	D	176	0	0	4	0
6	E	86	0	0	1	0
All	All	5753	0	4991	56	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 6.

The worst 5 of 56 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)
4:D:204:ARG:HD3	6:D:402:HOH:O	1.70	0.90
2:B:272:GLU:O	2:B:273:ASN:HB2	1.83	0.76
1:A:227:LYS:NZ	5:A:301:ACT:H1	2.01	0.76
4:D:268:LYS:NZ	4:E:250:LYS:HE3	2.03	0.73
4:D:268:LYS:HZ2	4:E:250:LYS:HE3	1.54	0.73

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	125/121 (103%)	123 (98%)	2 (2%)	0	100	100
2	B	122/121 (101%)	120 (98%)	2 (2%)	0	100	100
3	C	117/121 (97%)	116 (99%)	1 (1%)	0	100	100
4	D	120/121 (99%)	116 (97%)	4 (3%)	0	100	100
4	E	121/121 (100%)	115 (95%)	6 (5%)	0	100	100
All	All	605/605 (100%)	590 (98%)	15 (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	114/107 (106%)	112 (98%)	2 (2%)	54	37
2	B	112/107 (105%)	111 (99%)	1 (1%)	75	65
3	C	106/108 (98%)	106 (100%)	0	100	100
4	D	110/107 (103%)	110 (100%)	0	100	100
4	E	109/107 (102%)	104 (95%)	5 (5%)	23	7
All	All	551/536 (103%)	543 (98%)	8 (2%)	73	45

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	E	194	LYS
4	E	192[B]	ARG
4	E	180[B]	GLU
4	E	180[A]	GLU
4	E	192[A]	ARG

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

Mol	Chain	Res	Type
1	A	273	ASN
2	B	273	ASN
3	C	265	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](#)

5 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$
4	OCS	E	188	4	6,8,9	0.82	0	7,11,13	1.54	2 (28%)
2	CSD	B	188	2	4,7,8	3.04	1 (25%)	1,8,10	7.16	1 (100%)
4	OCS	D	188[B]	-	6,8,9	0.90	0	7,11,13	1.41	1 (14%)
4	OCS	D	188[A]	-	6,8,9	0.98	0	7,11,13	1.28	1 (14%)
1	CSX	A	188	1	3,6,7	0.69	0	1,6,8	1.33	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	OCS	E	188	4	-	3/4/7/9	-
2	CSD	B	188	2	-	0/2/6/8	-
4	OCS	D	188[B]	-	-	3/4/7/9	-
4	OCS	D	188[A]	-	-	4/4/7/9	-
1	CSX	A	188	1	-	0/2/5/7	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	188	CSD	OD1-SG	5.71	1.52	1.47

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	188	CSD	OD1-SG-CB	7.16	118.80	105.60
4	E	188	OCS	OD1-SG-CB	2.22	110.07	106.76
4	D	188[B]	OCS	OD2-SG-CB	2.21	110.24	105.97
4	D	188[A]	OCS	OD1-SG-CB	2.11	109.90	106.76
4	E	188	OCS	OD3-SG-CB	2.11	109.90	106.76

There are no chirality outliers.

5 of 10 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	D	188[A]	OCS	N-CA-CB-SG
4	D	188[A]	OCS	CA-CB-SG-OD1
4	D	188[A]	OCS	CA-CB-SG-OD2
4	D	188[A]	OCS	CA-CB-SG-OD3
4	D	188[B]	OCS	CA-CB-SG-OD2

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	E	188	OCS	1	0

## 5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

1 ligand is 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	$\# Z  > 2$
5	ACT	A	301	-	3,3,3	0.88	0	3,3,3	1.17	0

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.

1 monomer is involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	301	ACT	3	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, 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	119/121 (98%)	-0.35	2 (1%) 69 74	9, 18, 38, 45	8 (6%)
2	B	118/121 (97%)	-0.25	0 100 100	10, 21, 40, 52	6 (5%)
3	C	117/121 (96%)	-0.38	1 (0%) 81 85	9, 19, 36, 52	2 (1%)
4	D	116/121 (95%)	-0.32	1 (0%) 81 85	10, 19, 37, 53	6 (5%)
4	E	117/121 (96%)	0.43	2 (1%) 69 74	19, 37, 57, 84	6 (5%)
All	All	587/605 (97%)	-0.18	6 (1%) 79 84	9, 21, 46, 84	28 (4%)

The worst 5 of 6 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	D	273	ASN	2.9
4	E	159	LEU	2.7
3	C	273	ASN	2.4
1	A	155	SER	2.4
4	E	157	SER	2.2

### 6.2 Non-standard residues in protein, DNA, RNA chains [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(Å <sup>2</sup> )	Q<0.9
4	OCS	E	188	9/10	0.83	0.13	43,46,61,61	3
2	CSD	B	188	8/9	0.90	0.09	21,26,40,47	0
4	OCS	D	188[B]	9/10	0.93	0.08	18,26,30,35	4
4	OCS	D	188[A]	9/10	0.93	0.08	18,26,39,39	4
1	CSX	A	188	7/8	0.95	0.06	17,25,35,38	0

### 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, 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
5	ACT	A	301	4/4	0.80	0.12	26,33,36,45	0

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

There are no such residues in this entry.