



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 10, 2026 – 02:02 AM UTC

PDB ID : 1CS1 / pdb\_00001cs1  
Title : CYSTATHIONINE GAMMA-SYNTASE (CGS) FROM ESCHERICHIA COLI  
Authors : Clausen, T.; Messerschmidt, A.  
Deposited on : 1998-09-23  
Resolution : 1.50 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>.

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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

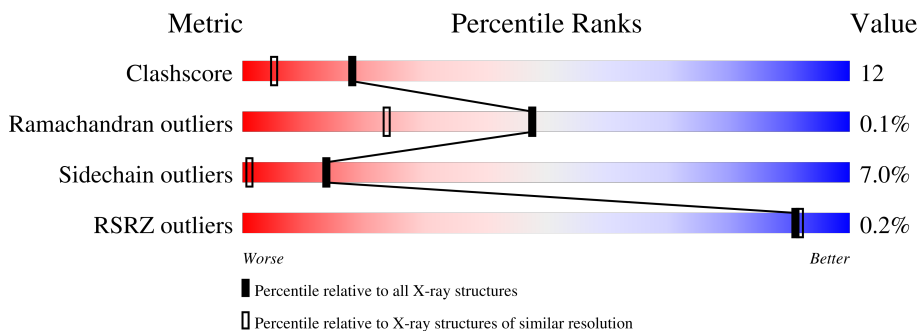
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.50 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))
Clashscore	190562	4235 (1.50-1.50)
Ramachandran outliers	187476	4153 (1.50-1.50)
Sidechain outliers	187428	4150 (1.50-1.50)
RSRZ outliers	180081	4039 (1.50-1.50)

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	386	 77% 20% ..
1	B	386	 70% 24% 5% .
1	C	386	 71% 25% .
1	D	386	 78% 19% ..

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 12992 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.

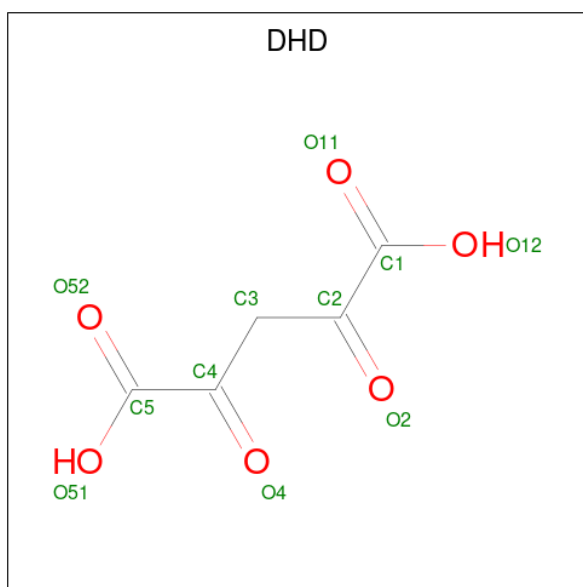
- Molecule 1 is a protein called PROTEIN (CYSTATHIONINE GAMMA-SYNTHASE).

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	384	2920	1836	520	553	1	10	0	0	0
1	B	384	2920	1836	520	553	1	10	0	0	0
1	C	384	2920	1836	520	553	1	10	0	0	0
1	D	384	2920	1836	520	553	1	10	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	198	LLP	LYS	modified residue	UNP P00935
B	198	LLP	LYS	modified residue	UNP P00935
C	198	LLP	LYS	modified residue	UNP P00935
D	198	LLP	LYS	modified residue	UNP P00935

- Molecule 2 is 2,4-DIOXO-PENTANEDIOIC ACID (CCD ID: DHD) (formula: C<sub>5</sub>H<sub>4</sub>O<sub>6</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	D	1	Total C O 11 5 6	0	0

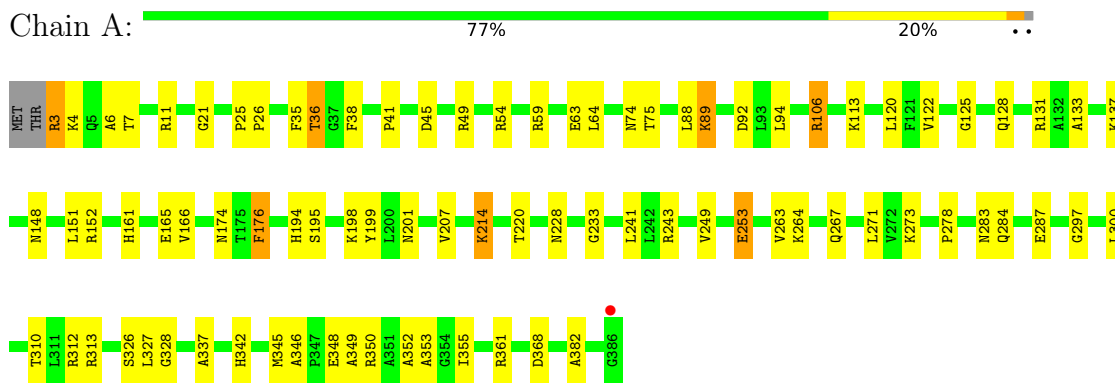
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	401	Total O 401 401	0	0
3	B	242	Total O 242 242	0	0
3	C	256	Total O 256 256	0	0
3	D	402	Total O 402 402	0	0

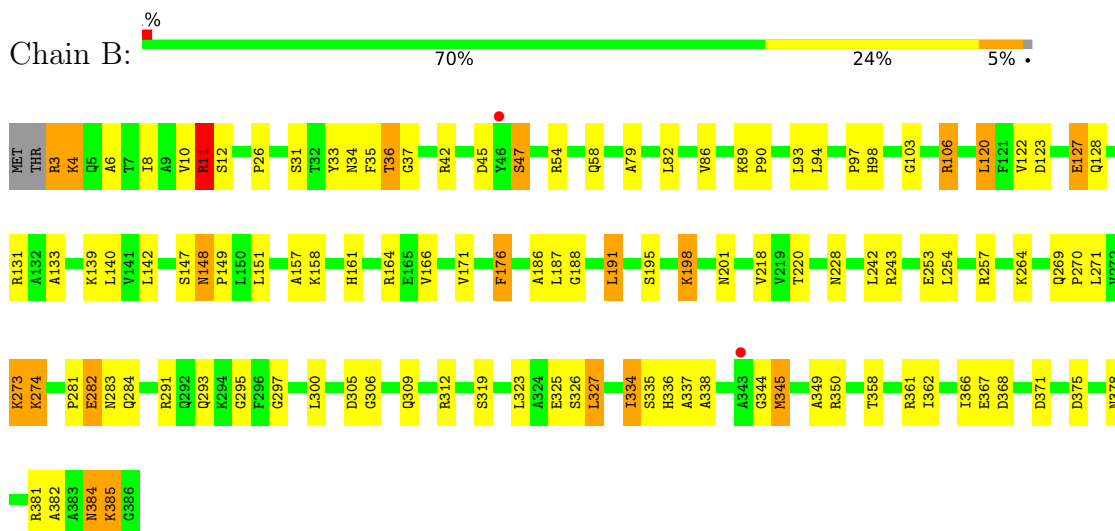
### 3 Residue-property plots [i](#)

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: PROTEIN (CYSTATHIONINE GAMMA-SYNTASE)



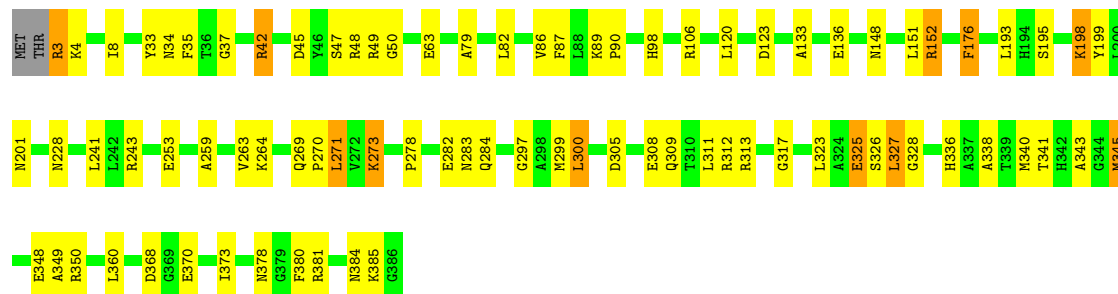
#### • Molecule 1: PROTEIN (CYSTATHIONINE GAMMA-SYNTASE)





• Molecule 1: PROTEIN (CYSTATHIONINE GAMMA-SYNTASE)

Chain D: 78% 19%



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	160.04Å 61.30Å 153.84Å 90.00° 104.18° 90.00°	Depositor
Resolution (Å)	8.00 – 1.50 8.00 – 1.50	Depositor EDS
% Data completeness (in resolution range)	86.9 (8.00-1.50) 85.6 (8.00-1.50)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	0.06	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	5.42 (at 1.50Å)	Xtrriage
Refinement program	X-PLOR 3.1	Depositor
R, $R_{free}$	0.200 , 0.255 0.198 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	23.7	Xtrriage
Anisotropy	0.160	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.26 , 92.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	12992	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	32.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.61% of the height of the origin peak. No significant pseudotranslation is detected.*

<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: DHD, LLP

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	0.53	0/2948	0.90	6/4002 (0.1%)
1	B	0.51	0/2948	0.96	13/4002 (0.3%)
1	C	0.53	0/2948	0.94	7/4002 (0.2%)
1	D	0.54	0/2948	0.91	6/4002 (0.1%)
All	All	0.52	0/11792	0.93	32/16008 (0.2%)

There are no bond length outliers.

The worst 5 of 32 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	231	VAL	N-CA-C	8.16	119.17	111.91
1	D	195	SER	N-CA-C	-7.98	95.56	108.41
1	B	195	SER	N-CA-C	-7.29	95.73	108.20
1	A	195	SER	N-CA-C	-7.26	95.78	108.20
1	B	79	ALA	N-CA-C	-6.73	104.02	111.36

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	2920	0	2915	71	0
1	B	2920	0	2917	91	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	2920	0	2916	96	0
1	D	2920	0	2916	68	0
2	D	11	0	3	0	0
3	A	401	0	0	11	3
3	B	242	0	0	11	2
3	C	256	0	0	10	1
3	D	402	0	0	8	2
All	All	12992	0	11667	286	4

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 12.

The worst 5 of 286 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:A:106:ARG:HG2	1:A:106:ARG:HH11	1.14	1.08
1:D:273:LYS:HE3	1:D:305:ASP:HA	1.34	1.08
1:D:151:LEU:HD23	1:D:278:PRO:HD3	1.52	0.91
1:B:345:MET:HE2	1:B:350:ARG:HG2	1.59	0.83
1:B:106:ARG:NH2	1:D:228:ASN:HA	1.92	0.83

All (4) 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	Interatomic distance (Å)	Clash overlap (Å)
3:A:526:HOH:O	3:B:521:HOH:O[3_455]	1.66	0.54
3:A:719:HOH:O	3:D:1596:HOH:O[3_455]	1.95	0.25
3:B:473:HOH:O	3:C:559:HOH:O[3_545]	2.11	0.09
3:A:660:HOH:O	3:D:1612:HOH:O[4_545]	2.14	0.06

## 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	381/386 (99%)	373 (98%)	8 (2%)	0	100	100
1	B	381/386 (99%)	368 (97%)	12 (3%)	1 (0%)	36	17
1	C	381/386 (99%)	370 (97%)	10 (3%)	1 (0%)	36	17
1	D	381/386 (99%)	369 (97%)	12 (3%)	0	100	100
All	All	1524/1544 (99%)	1480 (97%)	42 (3%)	2 (0%)	48	24

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	345	MET
1	C	385	LYS

### 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	304/307 (99%)	287 (94%)	17 (6%)	19	2
1	B	304/307 (99%)	276 (91%)	28 (9%)	8	0
1	C	304/307 (99%)	283 (93%)	21 (7%)	14	1
1	D	304/307 (99%)	285 (94%)	19 (6%)	16	1
All	All	1216/1228 (99%)	1131 (93%)	85 (7%)	14	1

5 of 85 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	283	ASN
1	D	120	LEU
1	C	287	GLU
1	C	378	ASN
1	D	273	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 38 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	342	HIS
1	D	293	GLN
1	D	34	ASN
1	D	228	ASN
1	D	384	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](#)

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
1	LLP	B	198	1	23,24,25	2.68	5 (21%)	25,32,34	2.17	8 (32%)
1	LLP	D	198	1	23,24,25	2.23	5 (21%)	25,32,34	2.12	7 (28%)
1	LLP	C	198	1	23,24,25	2.31	5 (21%)	25,32,34	2.20	8 (32%)
1	LLP	A	198	1	23,24,25	2.81	6 (26%)	25,32,34	2.24	7 (28%)

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. '2' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	LLP	B	198	1	-	6/16/17/19	0/1/1/1
1	LLP	D	198	1	-	6/16/17/19	0/1/1/1
1	LLP	C	198	1	-	6/16/17/19	0/1/1/1
1	LLP	A	198	1	-	5/16/17/19	0/1/1/1

The worst 5 of 21 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	198	LLP	C4-C5	8.81	1.54	1.42
1	B	198	LLP	C4-C5	7.86	1.52	1.42
1	B	198	LLP	C3-C2	7.54	1.48	1.41
1	A	198	LLP	C3-C2	7.26	1.48	1.41
1	C	198	LLP	C4-C5	6.71	1.51	1.42

The worst 5 of 30 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	198	LLP	C2'-C2-C3	6.53	128.44	120.80
1	B	198	LLP	C2'-C2-C3	6.14	127.99	120.80
1	D	198	LLP	C2'-C2-C3	5.81	127.60	120.80
1	C	198	LLP	C2'-C2-C3	5.77	127.56	120.80
1	D	198	LLP	C6-N1-C2	3.85	126.17	119.20

There are no chirality outliers.

5 of 23 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	198	LLP	O-C-CA-CB
1	B	198	LLP	O-C-CA-CB
1	C	198	LLP	O-C-CA-CB
1	D	198	LLP	O-C-CA-CB
1	C	198	LLP	CA-CB-CG-CD

There are no ring outliers.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	B	198	LLP	2	0
1	D	198	LLP	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
2	DHD	D	1501	-	10,10,10	4.84	5 (50%)	10,13,13	1.43	2 (20%)

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	DHD	D	1501	-	-	0/12/12/12	-

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	1501	DHD	O52-C5	11.30	1.50	1.22
2	D	1501	DHD	O12-C1	7.31	1.50	1.30
2	D	1501	DHD	C2-C1	-4.72	1.46	1.53
2	D	1501	DHD	C4-C5	-4.68	1.46	1.53
2	D	1501	DHD	O51-C5	-2.96	1.22	1.30

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	1501	DHD	O12-C1-C2	2.32	120.01	113.59
2	D	1501	DHD	O51-C5-C4	2.29	119.93	113.59

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

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	383/386 (99%)	-0.54	1 (0%) 90 91	17, 24, 47, 95	0
1	B	383/386 (99%)	-0.24	2 (0%) 87 89	18, 31, 64, 99	0
1	C	383/386 (99%)	-0.24	0 100 100	19, 31, 57, 97	0
1	D	383/386 (99%)	-0.53	0 100 100	17, 23, 53, 91	0
All	All	1532/1544 (99%)	-0.39	3 (0%) 91 92	17, 27, 56, 99	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	386	GLY	4.5
1	B	343	ALA	2.7
1	B	46	TYR	2.4

### 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
1	LLP	C	198	24/25	0.97	0.05	19,25,30,32	0
1	LLP	B	198	24/25	0.98	0.05	21,26,41,43	0
1	LLP	A	198	24/25	0.98	0.04	17,20,25,32	0
1	LLP	D	198	24/25	0.98	0.04	16,21,28,36	0

### 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	DHD	D	1501	11/11	0.91	0.11	52,56,65,67	11

## 6.5 Other polymers [i](#)

There are no such residues in this entry.