



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 26, 2026 – 05:33 PM UTC

PDB ID : 4NAP / pdb_00004nap
Title : Crystal structure of a trap periplasmic solute binding protein from *Desulfovibrio alaskensis* G20 (DDE_0634), target EFI-510102, with bound d-tryptophan
Authors : Vetting, M.W.; Al Obaidi, N.F.; Morisco, L.L.; Wasserman, S.R.; Sojitra, S.; Stead, M.; Attonito, J.D.; Scott Glenn, A.; Chowdhury, S.; Evans, B.; Hillerich, B.; Love, J.; Seidel, R.D.; Imker, H.J.; Gerlt, J.A.; Almo, S.C.; Enzyme Function Initiative (EFI)
Deposited on : 2013-10-22
Resolution : 2.30 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

<https://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)

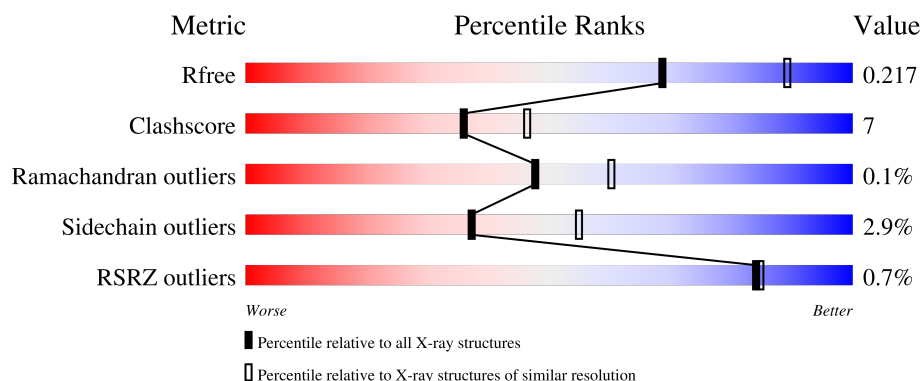
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	312	 86% 12% ..
1	B	312	 87% 12% ..
1	C	312	 2% 84% 14% ..
1	D	312	 88% 10% ..

Validation Pipeline (wwPDB-VP) : 2.49

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 19286 atoms, of which 9389 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.

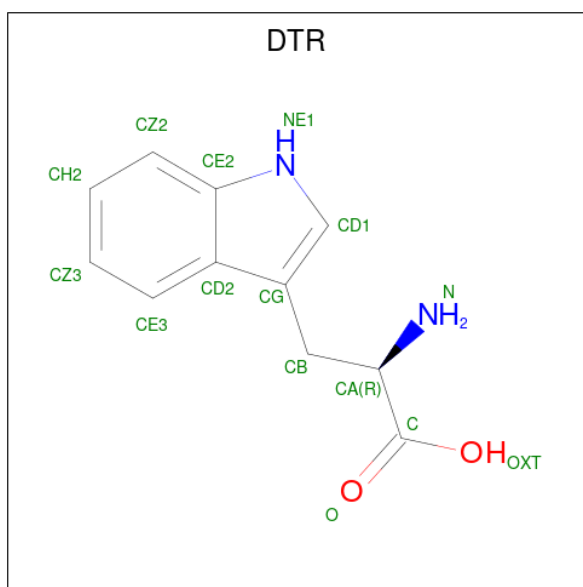
- Molecule 1 is a protein called Extracellular solute-binding protein, family 7.

Mol	Chain	Residues	Atoms								ZeroOcc	AltConf	Trace
1	A	308	Total	C	H	N	O	S	Se		0	0	0
			4701	1499	2337	409	438	2	16				
1	B	309	Total	C	H	N	O	S	Se		0	0	0
			4711	1502	2340	413	438	2	16				
1	C	309	Total	C	H	N	O	S	Se		0	0	0
			4722	1503	2352	414	435	2	16				
1	D	310	Total	C	H	N	O	S	Se		0	0	0
			4742	1508	2360	415	441	2	16				

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	30	MSE	-	expression tag	UNP Q315G1
B	30	MSE	-	expression tag	UNP Q315G1
C	30	MSE	-	expression tag	UNP Q315G1
D	30	MSE	-	expression tag	UNP Q315G1

- Molecule 2 is D-TRYPTOPHAN (CCD ID: DTR) (formula: C₁₁H₁₂N₂O₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			15	11	2	2		
2	B	1	Total	C	N	O	0	0
			15	11	2	2		
2	C	1	Total	C	N	O	0	0
			15	11	2	2		
2	D	1	Total	C	N	O	0	0
			15	11	2	2		

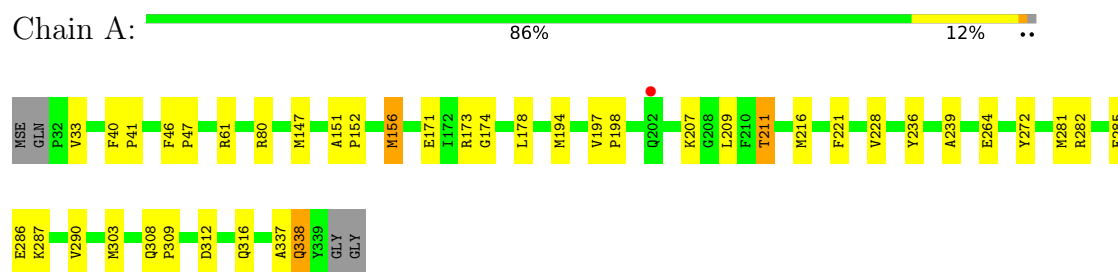
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	97	Total	O	0	0
			97	97		
3	B	93	Total	O	0	0
			93	93		
3	C	76	Total	O	0	0
			76	76		
3	D	84	Total	O	0	0
			84	84		

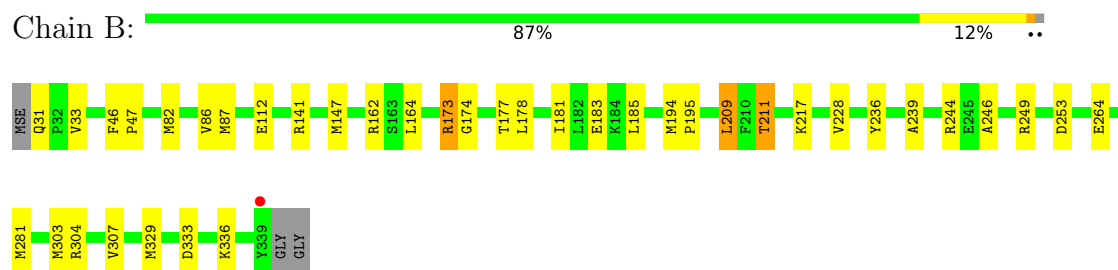
3 Residue-property plots [i](#)

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.

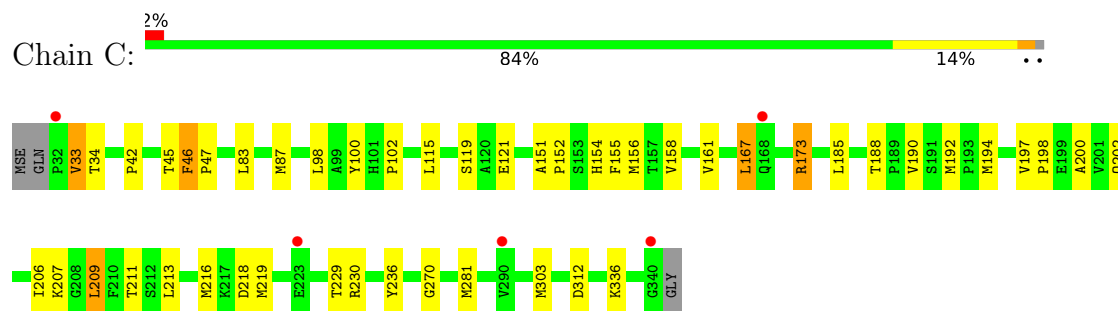
- Molecule 1: Extracellular solute-binding protein, family 7



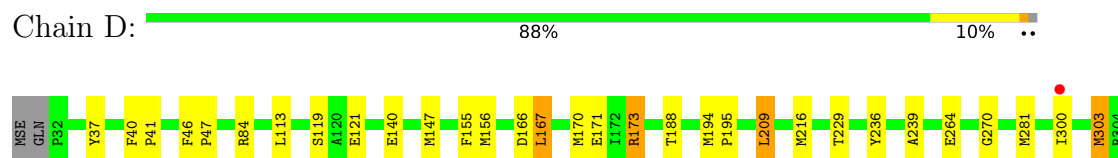
- Molecule 1: Extracellular solute-binding protein, family 7



- Molecule 1: Extracellular solute-binding protein, family 7



- Molecule 1: Extracellular solute-binding protein, family 7



R306	
D312	
D333	
K336	
G341	

4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	50.12Å 144.57Å 96.39Å 90.00° 90.52° 90.00°	Depositor
Resolution (Å)	31.43 – 2.30 31.43 – 2.30	Depositor EDS
% Data completeness (in resolution range)	99.5 (31.43-2.30) 99.5 (31.43-2.30)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.08	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.61 (at 2.20Å)	Xtriage
Refinement program	PHENIX 1.8.1_1168	Depositor
R, R_{free}	0.163 , 0.215 0.167 , 0.217	Depositor DCC
R_{free} test set	3503 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	31.0	Xtriage
Anisotropy	0.256	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 42.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.53$, $\langle L^2 \rangle = 0.36$	Xtriage
Estimated twinning fraction	0.037 for h,-k,-l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	19286	wwPDB-VP
Average B, all atoms (Å ²)	44.0	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 45.82 % 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 1.2501e-04. 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 ⓘ

5.1 Standard geometry ⓘ

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

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	0.94	1/2405 (0.0%)	0.90	0/3247
1	B	0.94	1/2412 (0.0%)	0.96	2/3258 (0.1%)
1	C	0.80	0/2411	0.92	2/3253 (0.1%)
1	D	0.84	0/2423	0.92	2/3269 (0.1%)
All	All	0.88	2/9651 (0.0%)	0.92	6/13027 (0.0%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	211	THR	C-O	-5.58	1.19	1.24
1	A	211	THR	C-O	-5.46	1.19	1.24

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	113	LEU	CA-C-N	5.30	126.46	119.84
1	D	113	LEU	C-N-CA	5.30	126.46	119.84
1	C	46	PHE	CA-C-N	-5.28	113.47	119.28
1	C	46	PHE	C-N-CA	-5.28	113.47	119.28
1	B	31	GLN	CA-C-N	5.21	125.42	120.31

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	2364	2337	2329	49	0
1	B	2371	2340	2332	29	1
1	C	2370	2352	2346	38	0
1	D	2382	2360	2352	26	1
2	A	15	0	11	4	0
2	B	15	0	11	5	0
2	C	15	0	11	4	0
2	D	15	0	11	5	0
3	A	97	0	0	2	0
3	B	93	0	0	5	0
3	C	76	0	0	1	0
3	D	84	0	0	1	0
All	All	9897	9389	9403	139	1

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 7.

The worst 5 of 139 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:C:156:MSE:HE3	1:C:209:LEU:HG	1.57	0.86
1:D:216:MSE:HG3	1:D:281:MSE:CE	2.07	0.84
1:A:216:MSE:HE2	1:A:221:PHE:HB2	1.67	0.77
1:A:156:MSE:CE	1:A:216:MSE:HE3	2.18	0.73
1:C:173:ARG:HD3	1:C:173:ARG:C	2.14	0.73

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	Interatomic distance (Å)	Clash overlap (Å)
1:B:253:ASP:OD1	1:D:84:ARG:NH2[2_757]	2.15	0.05

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	306/312 (98%)	297 (97%)	8 (3%)	1 (0%)	36	46
1	B	307/312 (98%)	301 (98%)	6 (2%)	0	100	100
1	C	307/312 (98%)	297 (97%)	10 (3%)	0	100	100
1	D	308/312 (99%)	301 (98%)	7 (2%)	0	100	100
All	All	1228/1248 (98%)	1196 (97%)	31 (2%)	1 (0%)	48	60

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	338	GLN

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	248/236 (105%)	243 (98%)	5 (2%)	48	67
1	B	248/236 (105%)	240 (97%)	8 (3%)	34	51
1	C	248/236 (105%)	240 (97%)	8 (3%)	34	51
1	D	250/236 (106%)	242 (97%)	8 (3%)	34	51
All	All	994/944 (105%)	965 (97%)	29 (3%)	37	55

5 of 29 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	98	LEU
1	D	303	MSE
1	C	173	ARG
1	D	167	LEU
1	C	167	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such

sidechains are listed below:

Mol	Chain	Res	Type
1	B	101	HIS
1	B	168	GLN
1	B	256	GLN
1	C	227	HIS
1	D	256	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](#)

4 ligands 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	DTR	A	401	-	15,16,16	1.07	1 (6%)	18,22,22	0.86	1 (5%)
2	DTR	D	401	-	15,16,16	0.89	1 (6%)	18,22,22	0.93	1 (5%)
2	DTR	C	401	-	15,16,16	0.71	0	18,22,22	0.85	1 (5%)
2	DTR	B	401	-	15,16,16	0.84	1 (6%)	18,22,22	0.81	1 (5%)

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	DTR	A	401	-	-	3/8/8/8	0/2/2/2
2	DTR	D	401	-	-	4/8/8/8	0/2/2/2
2	DTR	C	401	-	-	4/8/8/8	0/2/2/2
2	DTR	B	401	-	-	2/8/8/8	0/2/2/2

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	401	DTR	OXT-C	-2.59	1.22	1.30
2	D	401	DTR	OXT-C	-2.47	1.22	1.30
2	B	401	DTR	OXT-C	-2.04	1.24	1.30

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	D	401	DTR	CA-CB-CG	3.19	119.54	113.49
2	C	401	DTR	CA-CB-CG	2.24	117.75	113.49
2	A	401	DTR	OXT-C-O	-2.18	119.13	124.08
2	B	401	DTR	CA-CB-CG	2.06	117.40	113.49

There are no chirality outliers.

5 of 13 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	401	DTR	N-CA-CB-CG
2	B	401	DTR	C-CA-CB-CG
2	C	401	DTR	N-CA-CB-CG
2	A	401	DTR	OXT-C-CA-CB
2	C	401	DTR	OXT-C-CA-CB

There are no ring outliers.

4 monomers are involved in 18 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	401	DTR	4	0
2	D	401	DTR	5	0
2	C	401	DTR	4	0
2	B	401	DTR	5	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, 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	292/312 (93%)	-0.34	1 (0%) 90 90	20, 39, 69, 99	0
1	B	293/312 (93%)	-0.54	1 (0%) 90 90	15, 33, 62, 90	0
1	C	293/312 (93%)	-0.13	5 (1%) 69 70	22, 47, 89, 105	0
1	D	294/312 (94%)	-0.41	1 (0%) 90 90	16, 39, 74, 97	0
All	All	1172/1248 (93%)	-0.35	8 (0%) 84 85	15, 39, 78, 105	0

The worst 5 of 8 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	340	GLY	4.6
1	A	202	GLN	3.4
1	C	32	PRO	3.3
1	C	223	GLU	3.0
1	B	339	TYR	2.8

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, 95th 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	DTR	A	401	15/15	0.96	0.06	19,23,37,39	0
2	DTR	C	401	15/15	0.96	0.07	22,27,42,43	0
2	DTR	B	401	15/15	0.97	0.06	12,19,38,41	0
2	DTR	D	401	15/15	0.97	0.06	17,23,42,45	0

6.5 Other polymers [i](#)

There are no such residues in this entry.