



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 18, 2026 – 05:40 PM UTC

PDB ID : 4P12 / pdb_00004p12
Title : Native Structure of the P domain from a GI.7 Norovirus variant.
Authors : Shanker, S.; Czako, R.; Sankaran, B.; Atmar, R.; Estes, M.; Prasad, B.V.V.
Deposited on : 2014-02-24
Resolution : 1.60 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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

<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
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

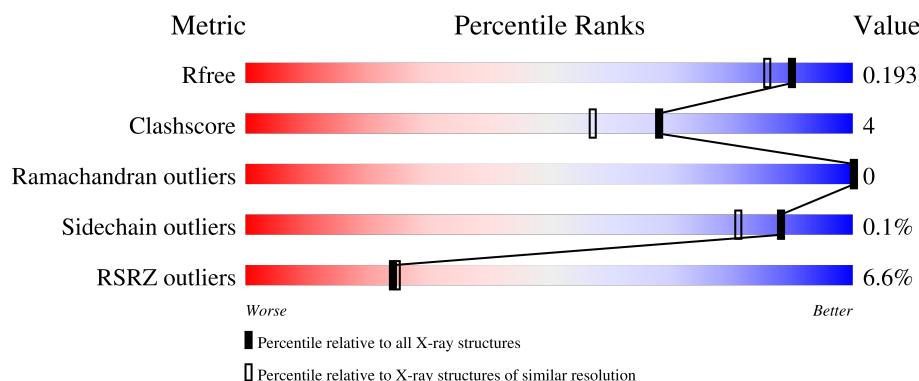
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.60 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	4673 (1.60-1.60)
Clashscore	190562	4931 (1.60-1.60)
Ramachandran outliers	187476	4831 (1.60-1.60)
Sidechain outliers	187428	4830 (1.60-1.60)
RSRZ outliers	180081	4672 (1.60-1.60)

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	301	6% 91% 6% ..
1	B	301	8% 85% 10% ..
1	C	301	6% 93% 5% .
1	D	301	6% 88% 9% .

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 10312 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 Major capsid protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	296	Total	C	N	O	S	0	1	0
			2253	1433	381	431	8			
1	B	288	Total	C	N	O	S	0	0	0
			2201	1401	375	417	8			
1	C	295	Total	C	N	O	S	0	0	0
			2233	1422	376	427	8			
1	D	290	Total	C	N	O	S	0	0	0
			2207	1408	371	420	8			

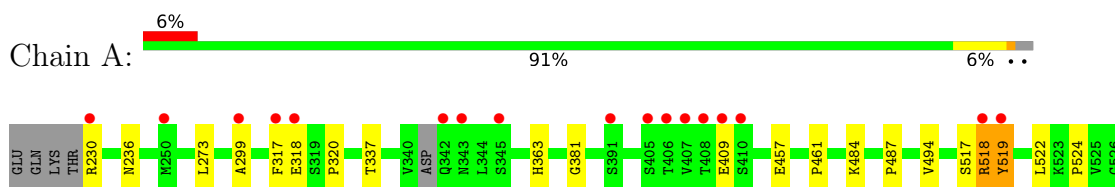
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	339	Total	O	0	0
			339	339		
2	B	337	Total	O	0	0
			337	337		
2	C	365	Total	O	0	0
			365	365		
2	D	377	Total	O	0	0
			377	377		

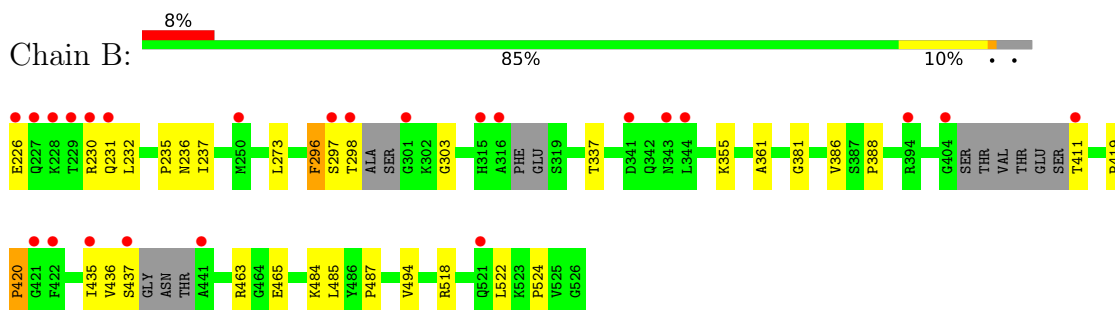
3 Residue-property plots [i](#)

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.

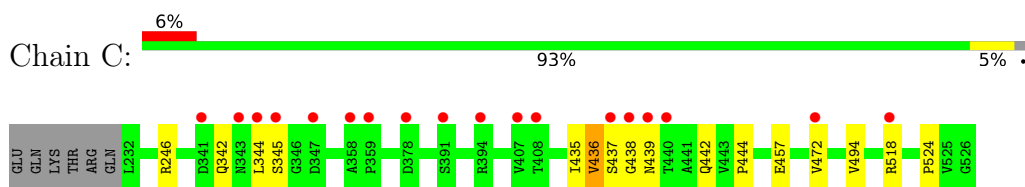
- Molecule 1: Major capsid protein



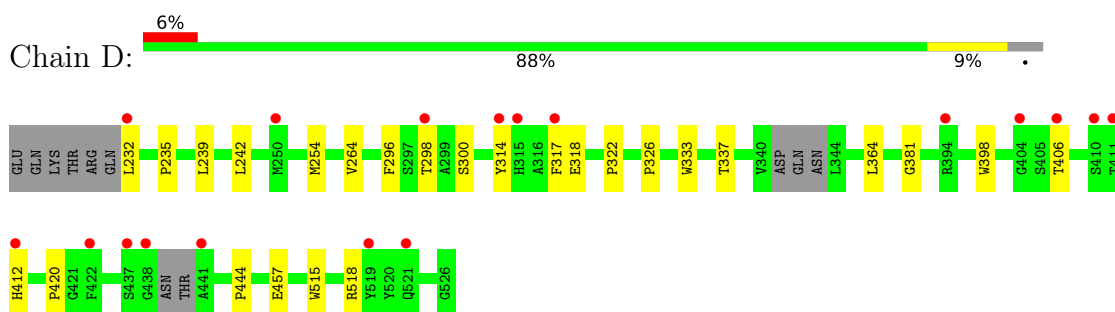
- Molecule 1: Major capsid protein



- Molecule 1: Major capsid protein



- Molecule 1: Major capsid protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	62.18Å 63.18Å 90.47Å 99.51° 97.89° 119.17°	Depositor
Resolution (Å)	39.02 – 1.60 39.02 – 1.60	Depositor EDS
% Data completeness (in resolution range)	94.7 (39.02-1.60) 94.6 (39.02-1.60)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.67 (at 1.60Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.1_1168)	Depositor
R, R_{free}	0.155 , 0.182 0.171 , 0.193	Depositor DCC
R_{free} test set	7190 reflections (4.76%)	wwPDB-VP
Wilson B-factor (Å ²)	14.3	Xtriage
Anisotropy	0.031	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 42.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.004 for -k,-h,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	10312	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.20% of the height of the origin peak. No significant pseudotranslation is detected.*

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

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	0.50	1/2322 (0.0%)	0.79	2/3178 (0.1%)
1	B	0.52	2/2263 (0.1%)	0.78	0/3092
1	C	0.54	3/2300 (0.1%)	0.82	2/3150 (0.1%)
1	D	0.47	1/2272 (0.0%)	0.78	0/3108
All	All	0.51	7/9157 (0.1%)	0.79	4/12528 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	436	VAL	C-O	-5.78	1.17	1.24
1	B	296	PHE	C-O	-5.66	1.17	1.24
1	A	320	PRO	C-O	-5.62	1.17	1.24
1	C	435	ILE	C-O	-5.15	1.18	1.24
1	B	420	PRO	C-O	-5.11	1.17	1.24
1	C	442	GLN	C-O	-5.10	1.17	1.23
1	D	300	SER	C-O	-5.07	1.17	1.24

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	518	ARG	N-CA-C	-10.51	100.26	112.87
1	C	518	ARG	N-CA-C	-8.58	101.93	111.28
1	C	472	VAL	N-CA-C	5.11	115.32	108.17
1	A	299	ALA	N-CA-C	-5.03	105.89	112.23

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	519	TYR	Mainchain

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	2253	0	2168	18	0
1	B	2201	0	2122	25	0
1	C	2233	0	2142	10	0
1	D	2207	0	2135	17	0
2	A	339	0	0	0	2
2	B	337	0	0	4	0
2	C	365	0	0	0	1
2	D	377	0	0	1	2
All	All	10312	0	8567	63	3

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 4.

All (63) 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:B:235:PRO:HA	1:C:457:GLU:OE1	1.70	0.90
1:A:517:SER:C	1:A:519:TYR:H	1.94	0.73
1:C:436:VAL:O	1:C:437:SER:HB2	1.91	0.71
1:A:317:PHE:CE1	1:A:318:GLU:HG3	2.28	0.68
1:A:518:ARG:HG2	1:A:518:ARG:HH11	1.64	0.63
1:D:314:TYR:CD1	1:D:322:PRO:HG3	2.36	0.61
1:A:517:SER:C	1:A:519:TYR:N	2.47	0.61
1:B:296:PHE:CZ	1:B:303:GLY:HA3	2.36	0.60
1:D:296:PHE:CE2	1:D:298:THR:HG22	2.36	0.60
1:A:517:SER:O	1:A:519:TYR:N	2.35	0.60
1:C:342:GLN:O	1:C:344:LEU:HG	2.02	0.59
1:B:273:LEU:HD12	1:B:487:PRO:HA	1.85	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:465:GLU:HB3	1:B:518:ARG:HB3	1.88	0.56
1:A:363:HIS:HD2	1:A:409:GLU:OE2	1.90	0.55
1:D:318:GLU:HG2	1:D:412:HIS:CD2	2.42	0.54
1:D:239:LEU:HD12	1:D:242:LEU:HD12	1.90	0.54
1:B:237:ILE:HG13	1:C:457:GLU:HG3	1.89	0.54
1:A:517:SER:O	1:A:518:ARG:C	2.51	0.53
1:B:484:LYS:HG3	1:B:522:LEU:HD21	1.91	0.52
1:B:235:PRO:CA	1:C:457:GLU:OE1	2.51	0.51
1:A:518:ARG:HH11	1:A:518:ARG:CG	2.23	0.51
1:B:226:GLU:N	2:B:910:HOH:O	2.43	0.51
1:B:436:VAL:O	1:B:437:SER:CB	2.58	0.51
1:D:337:THR:HG22	1:D:381:GLY:HA3	1.93	0.51
1:C:494:VAL:O	1:C:524:PRO:HA	2.12	0.50
1:A:236:ASN:HB3	1:D:457:GLU:HG2	1.94	0.49
1:D:364:LEU:HD21	1:D:406:THR:HG21	1.95	0.49
1:D:264:VAL:HG22	2:D:857:HOH:O	2.12	0.49
1:B:337:THR:HG22	1:B:381:GLY:HA3	1.95	0.49
1:A:337:THR:HG22	1:A:381:GLY:HA3	1.95	0.48
1:A:484:LYS:HG3	1:A:522:LEU:HD21	1.94	0.48
1:A:273:LEU:HG	1:A:487:PRO:HA	1.95	0.48
1:B:236:ASN:HB3	1:C:457:GLU:HG2	1.96	0.47
1:B:361:ALA:HB3	2:B:848:HOH:O	2.13	0.47
1:A:230:ARG:O	1:A:461:PRO:HD2	2.15	0.46
1:D:318:GLU:HG2	1:D:412:HIS:NE2	2.31	0.45
1:B:419:PRO:HA	1:B:420:PRO:HD3	1.88	0.45
1:B:494:VAL:O	1:B:524:PRO:HA	2.16	0.44
1:C:438:GLY:O	1:C:439:ASN:CB	2.64	0.44
1:D:232:LEU:HD22	1:D:515:TRP:CH2	2.52	0.44
1:A:317:PHE:CD1	1:A:318:GLU:HG3	2.53	0.43
1:A:518:ARG:CG	1:A:518:ARG:NH1	2.80	0.43
1:B:236:ASN:N	1:C:457:GLU:OE1	2.50	0.43
1:B:230:ARG:O	1:B:463:ARG:NH2	2.42	0.43
1:D:317:PHE:CG	1:D:318:GLU:N	2.87	0.43
1:B:463:ARG:NH1	2:B:926:HOH:O	2.52	0.42
1:D:326:PRO:HB2	1:D:333:TRP:CH2	2.53	0.42
1:A:457:GLU:OE1	1:D:235:PRO:HA	2.20	0.42
1:B:355:LYS:HE3	1:B:355:LYS:HB3	1.86	0.42
1:D:420:PRO:HB2	1:D:518:ARG:HH12	1.85	0.41
1:A:518:ARG:HG2	1:A:518:ARG:O	2.19	0.41
1:A:494:VAL:O	1:A:524:PRO:HA	2.21	0.41
1:B:273:LEU:CD1	1:B:487:PRO:HA	2.51	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:273:LEU:HD21	1:B:485:LEU:CG	2.51	0.41
1:B:388:PRO:HG3	1:B:437:SER:HB3	2.02	0.41
1:D:239:LEU:HD21	1:D:254:MET:HG3	2.01	0.41
1:C:246:ARG:HD3	1:C:444:PRO:O	2.21	0.41
1:B:297:SER:C	1:B:298:THR:CG2	2.95	0.40
1:D:398:TRP:CD2	1:D:444:PRO:HG3	2.57	0.40
1:B:231:GLN:O	1:B:232:LEU:C	2.65	0.40
1:D:314:TYR:CG	1:D:322:PRO:HG3	2.57	0.40
1:B:386:VAL:HG23	1:B:435:ILE:HG23	2.02	0.40
1:B:411:THR:HA	2:B:913:HOH:O	2.22	0.40

All (3) 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)
2:A:650:HOH:O	2:D:644:HOH:O[1_545]	1.89	0.31
2:A:612:HOH:O	2:A:649:HOH:O[1_655]	1.91	0.29
2:C:653:HOH:O	2:D:634:HOH:O[1_445]	1.99	0.21

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	293/301 (97%)	282 (96%)	11 (4%)	0	100	100
1	B	278/301 (92%)	270 (97%)	8 (3%)	0	100	100
1	C	293/301 (97%)	282 (96%)	11 (4%)	0	100	100
1	D	284/301 (94%)	271 (95%)	13 (5%)	0	100	100
All	All	1148/1204 (95%)	1105 (96%)	43 (4%)	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	250/257 (97%)	250 (100%)	0	100	100
1	B	244/257 (95%)	244 (100%)	0	100	100
1	C	246/257 (96%)	245 (100%)	1 (0%)	84	75
1	D	246/257 (96%)	246 (100%)	0	100	100
All	All	986/1028 (96%)	985 (100%)	1 (0%)	88	81

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	345	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	276	GLN
1	A	363	HIS
1	A	442	GLN
1	A	521	GLN
1	B	276	GLN
1	B	477	HIS
1	C	458	GLN
1	C	521	GLN
1	D	252	ASN
1	D	305	ASN
1	D	442	GLN
1	D	521	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](#)

There are no ligands in this entry.

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 ⓘ

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, 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	296/301 (98%)	-0.12	17 (5%) 29 30	7, 14, 38, 62	1 (0%)
1	B	288/301 (95%)	0.02	24 (8%) 17 17	8, 16, 38, 48	0
1	C	295/301 (98%)	-0.10	18 (6%) 27 27	7, 14, 35, 50	0
1	D	290/301 (96%)	-0.19	18 (6%) 26 27	7, 13, 29, 44	0
All	All	1169/1204 (97%)	-0.10	77 (6%) 24 25	7, 14, 35, 62	1 (0%)

All (77) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	314	TYR	6.6
1	C	344	LEU	6.5
1	B	298	THR	5.5
1	D	441	ALA	4.8
1	A	407	VAL	4.7
1	C	345	SER	4.2
1	C	437	SER	4.2
1	C	440	THR	4.2
1	A	391	SER	4.0
1	A	250	MET	4.0
1	C	407	VAL	3.8
1	B	230	ARG	3.8
1	B	250	MET	3.7
1	A	342	GLN	3.6
1	B	521	GLN	3.6
1	D	298	THR	3.6
1	A	299	ALA	3.5
1	D	250	MET	3.4
1	B	315	HIS	3.4
1	D	438	GLY	3.4
1	C	341	ASP	3.3

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Mol	Chain	Res	Type	RSRZ
1	B	301	GLY	3.3
1	B	316	ALA	3.3
1	B	231	GLN	3.1
1	A	519	TYR	3.1
1	C	358	ALA	3.1
1	C	408	THR	3.1
1	B	435	ILE	3.0
1	C	391	SER	3.0
1	B	411	THR	3.0
1	B	441	ALA	3.0
1	A	518	ARG	2.9
1	C	394	ARG	2.9
1	B	437	SER	2.9
1	A	318	GLU	2.8
1	B	421	GLY	2.8
1	A	317	PHE	2.8
1	D	410	SER	2.8
1	D	521	GLN	2.8
1	D	232	LEU	2.7
1	D	317	PHE	2.7
1	B	344	LEU	2.7
1	B	404	GLY	2.7
1	C	347	ASP	2.7
1	B	422	PHE	2.7
1	B	226	GLU	2.7
1	D	406	THR	2.7
1	D	411	THR	2.7
1	D	412	HIS	2.6
1	B	229	THR	2.6
1	B	343	ASN	2.6
1	C	343	ASN	2.6
1	C	439	ASN	2.6
1	D	422	PHE	2.6
1	D	315	HIS	2.6
1	C	472	VAL	2.6
1	A	405	SER	2.5
1	D	437	SER	2.5
1	B	228	LYS	2.4
1	A	230	ARG	2.4
1	A	343	ASN	2.4
1	A	408	THR	2.4
1	D	519	TYR	2.3

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Mol	Chain	Res	Type	RSRZ
1	C	359	PRO	2.3
1	B	227	GLN	2.3
1	A	409	GLU	2.2
1	C	438	GLY	2.2
1	D	394	ARG	2.2
1	A	406	THR	2.2
1	B	341	ASP	2.1
1	A	410	SER	2.1
1	C	518	ARG	2.1
1	C	378	ASP	2.0
1	A	345	SER	2.0
1	B	297	SER	2.0
1	B	394	ARG	2.0
1	D	404	GLY	2.0

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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.