



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 7, 2026 – 01:26 AM UTC

PDB ID : 2Z58 / pdb_00002z58
Title : Crystal structure of G56W-propeptide:S324A-subtilisin complex
Authors : Pulido, M.A.; Tanaka, S.; Sringiew, C.; You, D.J.; Matsumura, H.; Koga, Y.;
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Deposited on : 2007-06-29
Resolution : 1.88 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

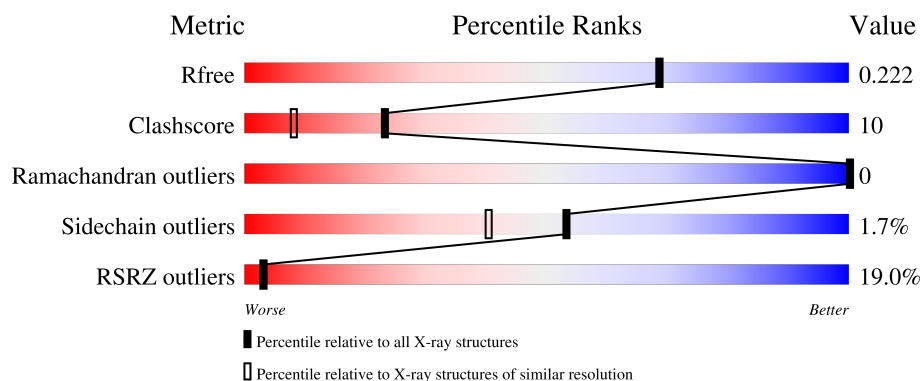
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.88 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	1220 (1.88-1.88)
Clashscore	190562	1234 (1.88-1.88)
Ramachandran outliers	187476	1222 (1.88-1.88)
Sidechain outliers	187428	1222 (1.88-1.88)
RSRZ outliers	180081	1220 (1.88-1.88)

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	318	16% 81% 18% .
2	B	66	32% 74% 23% .

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
3	CA	A	1002	-	-	X	-

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 3010 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 Tk-subtilisin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	318	Total	C	N	O	S	0	0	0
			2314	1452	384	472	6			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	324	ALA	SER	engineered mutation	UNP P58502

- Molecule 2 is a protein called Tk-subtilisin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	66	Total	C	N	O	S	0	0	0
			518	342	88	87	1			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	56	TRP	GLY	engineered mutation	UNP P58502

- Molecule 3 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	7	Total	Ca	0	0
			7	7		

- Molecule 4 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	B	1	Total	Zn	0	0
			1	1		

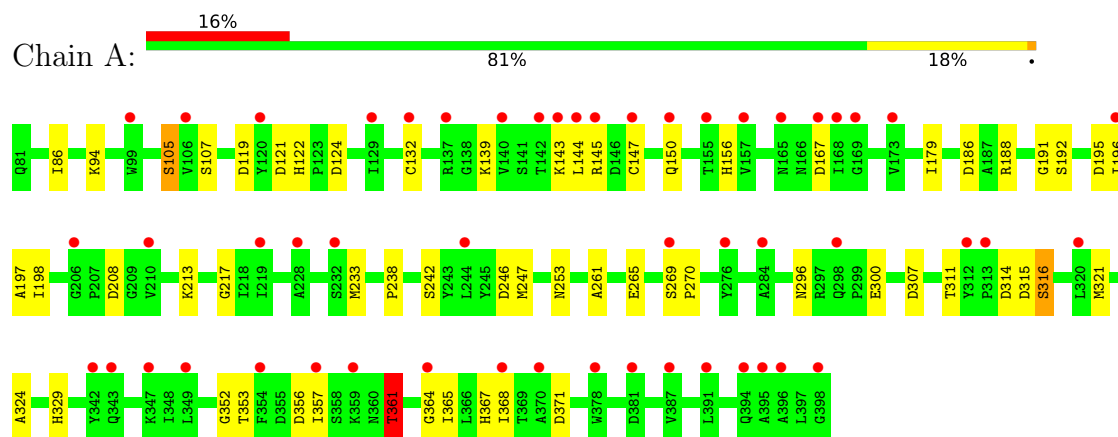
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	150	Total 150	O 150	0	0
5	B	20	Total 20	O 20	0	0

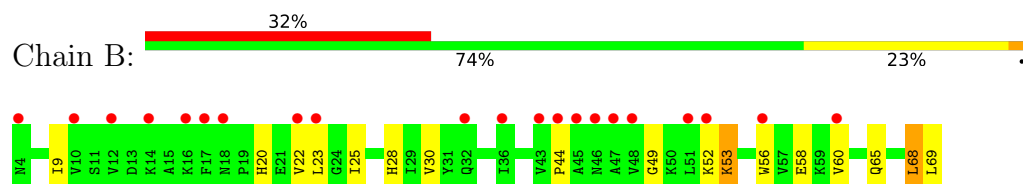
3 Residue-property plots [i](#)

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: Tk-subtilisin



• Molecule 2: Tk-subtilisin



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	64.84Å 67.34Å 74.03Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 1.88 49.82 – 1.88	Depositor EDS
% Data completeness (in resolution range)	99.0 (50.00-1.88) 99.0 (49.82-1.88)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.33 (at 1.88Å)	Xtriage
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.195 , 0.226 0.195 , 0.222	Depositor DCC
R_{free} test set	1343 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å ²)	22.5	Xtriage
Anisotropy	0.158	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 45.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.016 for k,h,-l	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	3010	wwPDB-VP
Average B, all atoms (Å ²)	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.20% 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

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

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	1.68	17/2361 (0.7%)	1.28	8/3235 (0.2%)
2	B	1.50	3/530 (0.6%)	1.18	2/719 (0.3%)
All	All	1.65	20/2891 (0.7%)	1.26	10/3954 (0.3%)

All (20) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	233	MET	SD-CE	-17.59	1.35	1.79
1	A	86	ILE	CA-CB	-9.60	1.43	1.53
1	A	247	MET	SD-CE	-9.05	1.56	1.79
1	A	361	THR	CB-CG2	-8.92	1.23	1.52
1	A	321	MET	SD-CE	-7.64	1.60	1.79
1	A	365	ILE	C-O	7.45	1.32	1.24
2	B	44	PRO	CA-C	6.63	1.60	1.52
2	B	60	VAL	CA-CB	-6.37	1.46	1.54
1	A	167	ASP	CA-C	-6.15	1.44	1.52
1	A	132	CYS	CA-CB	5.47	1.61	1.53
1	A	196	ILE	CA-C	-5.44	1.45	1.52
1	A	329	HIS	N-CA	-5.34	1.40	1.46
1	A	353	THR	C-O	-5.29	1.16	1.23
1	A	105	SER	CA-C	5.28	1.59	1.52
1	A	119	ASP	N-CA	5.27	1.53	1.46
1	A	253	ASN	CA-C	-5.13	1.45	1.52
1	A	197	ALA	CA-CB	-5.13	1.45	1.53
1	A	191	GLY	C-O	5.03	1.29	1.24
2	B	28	HIS	N-CA	-5.02	1.39	1.45
1	A	316	SER	CA-C	5.01	1.59	1.52

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	30	VAL	N-CA-C	-7.79	104.27	111.67
1	A	107	SER	N-CA-C	6.77	120.64	112.38
1	A	242	SER	N-CA-C	6.39	118.24	111.28
1	A	132	CYS	CB-CA-C	6.03	119.72	110.62
2	B	22	VAL	N-CA-C	5.71	116.44	110.62
1	A	198	ILE	CA-C-N	5.59	126.15	119.94
1	A	198	ILE	C-N-CA	5.59	126.15	119.94
1	A	179	ILE	N-CA-C	5.24	115.50	108.17
1	A	361	THR	CA-CB-CG2	5.17	119.29	110.50
1	A	361	THR	N-CA-CB	-5.17	101.92	111.53

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	2314	0	2239	39	2
2	B	518	0	547	21	0
3	A	7	0	0	2	0
4	B	1	0	0	0	0
5	A	150	0	0	11	0
5	B	20	0	0	5	0
All	All	3010	0	2786	58	2

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 10.

All (58) 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:94:LYS:NZ	5:A:1071:HOH:O	1.94	0.99
1:A:361:THR:HG22	1:A:364:GLY:H	1.30	0.93
2:B:53:LYS:HD2	2:B:53:LYS:N	1.89	0.87
3:A:1002:CA:CA	5:A:1097:HOH:O	1.58	0.81

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:68:LEU:HD12	2:B:68:LEU:O	1.81	0.80
1:A:314:ASP:OD2	5:A:1008:HOH:O	1.98	0.79
1:A:246:ASP:OD1	5:A:1019:HOH:O	2.05	0.73
2:B:58:GLU:OE1	5:B:277:HOH:O	2.05	0.73
1:A:238:PRO:HD2	5:B:270:HOH:O	1.88	0.72
2:B:52:LYS:C	2:B:53:LYS:HD2	2.14	0.71
1:A:122:HIS:HD2	1:A:124:ASP:H	1.39	0.70
1:A:307:ASP:OD2	5:A:1060:HOH:O	2.09	0.69
2:B:68:LEU:HD12	2:B:68:LEU:C	2.18	0.69
1:A:105:SER:OG	5:A:1156:HOH:O	2.12	0.68
1:A:371:ASP:OD1	5:A:1081:HOH:O	2.14	0.65
1:A:356:ASP:O	1:A:367:HIS:HD2	1.80	0.64
1:A:357:ILE:HB	1:A:368:ILE:HD11	1.79	0.64
1:A:122:HIS:HE1	1:A:316:SER:O	1.84	0.60
1:A:121:ASP:OD1	3:A:1002:CA:CA	1.78	0.60
1:A:300:GLU:OE2	1:A:367:HIS:HE1	1.85	0.59
2:B:49:GLY:HA2	2:B:52:LYS:HE2	1.84	0.58
1:A:357:ILE:CB	1:A:368:ILE:HD11	2.34	0.57
1:A:324:ALA:HB2	2:B:69:LEU:C	2.29	0.56
1:A:144:LEU:HA	1:A:147:CYS:SG	2.46	0.56
1:A:208:ASP:OD2	1:A:213:LYS:HD2	2.05	0.56
1:A:139:LYS:HE3	5:A:1062:HOH:O	2.04	0.56
2:B:52:LYS:HE3	2:B:53:LYS:HZ3	1.70	0.55
1:A:356:ASP:OD1	1:A:361:THR:HG21	2.07	0.55
2:B:9:ILE:HD12	2:B:9:ILE:N	2.23	0.54
2:B:25:ILE:C	2:B:25:ILE:HD12	2.33	0.53
1:A:150:GLN:HG3	5:A:1076:HOH:O	2.09	0.53
2:B:53:LYS:N	2:B:53:LYS:CD	2.70	0.51
2:B:68:LEU:C	2:B:68:LEU:CD1	2.84	0.51
2:B:20:HIS:CE1	5:B:278:HOH:O	2.65	0.50
1:A:265:GLU:H	1:A:296:ASN:HD21	1.58	0.50
1:A:352:GLY:HA3	1:A:361:THR:HG23	1.94	0.48
2:B:20:HIS:HE1	5:B:278:HOH:O	1.97	0.48
1:A:186:ASP:OD2	1:A:188:ARG:NH1	2.48	0.47
1:A:300:GLU:OE2	1:A:367:HIS:CE1	2.66	0.47
1:A:361:THR:CG2	1:A:364:GLY:H	2.15	0.47
1:A:269:SER:HB2	1:A:270:PRO:CD	2.46	0.46
1:A:357:ILE:CA	1:A:368:ILE:HD11	2.45	0.46
1:A:265:GLU:H	1:A:296:ASN:ND2	2.13	0.46
1:A:213:LYS:HE2	5:A:1043:HOH:O	2.15	0.45
1:A:186:ASP:OD2	1:A:188:ARG:CZ	2.64	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:23:LEU:C	2:B:23:LEU:HD23	2.42	0.45
1:A:213:LYS:CE	5:A:1043:HOH:O	2.65	0.44
1:A:361:THR:HG22	1:A:364:GLY:N	2.13	0.44
1:A:352:GLY:HA3	1:A:361:THR:CG2	2.48	0.44
1:A:261:ALA:HB3	2:B:69:LEU:HD12	1.99	0.43
1:A:156:HIS:HA	1:A:311:THR:O	2.19	0.43
2:B:56:TRP:CD1	2:B:56:TRP:H	2.37	0.43
1:A:324:ALA:CB	2:B:69:LEU:C	2.91	0.42
1:A:368:ILE:HG23	1:A:368:ILE:HD12	1.71	0.42
2:B:65:GLN:HE21	2:B:65:GLN:HB3	1.57	0.42
1:A:192:SER:OG	1:A:195:ASP:CG	2.63	0.42
2:B:49:GLY:O	2:B:53:LYS:HD3	2.21	0.41
2:B:58:GLU:CD	5:B:277:HOH:O	2.57	0.40

All (2) 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:A:145:ARG:NH2	1:A:217:GLY:O[4_455]	1.28	0.92
1:A:145:ARG:NH2	1:A:217:GLY:C[4_455]	2.19	0.01

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	316/318 (99%)	302 (96%)	14 (4%)	0	100	100
2	B	64/66 (97%)	64 (100%)	0	0	100	100
All	All	380/384 (99%)	366 (96%)	14 (4%)	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	242/242 (100%)	239 (99%)	3 (1%)	63	53
2	B	57/57 (100%)	55 (96%)	2 (4%)	32	15
All	All	299/299 (100%)	294 (98%)	5 (2%)	53	40

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	143	LYS
1	A	315	ASP
1	A	361	THR
2	B	53	LYS
2	B	68	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	122	HIS
1	A	150	GLN
1	A	253	ASN
1	A	290	ASN
1	A	296	ASN
1	A	298	GLN
1	A	343	GLN
1	A	367	HIS
2	B	65	GLN

5.3.3 RNA ⓘ

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](#)

Of 8 ligands modelled in this entry, 8 are monoatomic - leaving 0 for Mogul analysis.

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.

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 [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	318/318 (100%)	1.00	52 (16%) 4 5	15, 21, 32, 48	0
2	B	66/66 (100%)	1.68	21 (31%) 1 1	20, 28, 45, 51	0
All	All	384/384 (100%)	1.12	73 (19%) 3 3	15, 22, 37, 51	0

All (73) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	99	TRP	7.4
2	B	48	VAL	5.8
2	B	56	TRP	5.3
1	A	147	CYS	5.1
1	A	398	GLY	5.0
1	A	145	ARG	5.0
1	A	167	ASP	4.9
1	A	368	ILE	4.7
1	A	143	LYS	4.6
1	A	132	CYS	4.4
1	A	381	ASP	4.4
1	A	144	LEU	4.4
2	B	22	VAL	4.3
1	A	196	ILE	3.9
1	A	347	LYS	3.9
1	A	276	TYR	3.8
2	B	14	LYS	3.7
1	A	313	PRO	3.7
2	B	43	VAL	3.6
2	B	46	ASN	3.5
2	B	23	LEU	3.5
2	B	36	ILE	3.5
1	A	387	VAL	3.4
2	B	45	ALA	3.4

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Mol	Chain	Res	Type	RSRZ
1	A	349	LEU	3.4
1	A	359	LYS	3.2
2	B	51	LEU	3.2
1	A	137	ARG	3.2
2	B	47	ALA	3.1
1	A	219	ILE	3.1
2	B	32	GLN	3.1
1	A	165	ASN	3.1
2	B	10	VAL	3.1
2	B	60	VAL	3.1
1	A	150	GLN	3.1
1	A	312	TYR	3.0
1	A	342	TYR	3.0
2	B	4	ASN	3.0
1	A	244	LEU	2.9
1	A	391	LEU	2.9
1	A	173	VAL	2.8
2	B	52	LYS	2.7
1	A	210	VAL	2.7
1	A	169	GLY	2.7
1	A	228	ALA	2.6
1	A	378	TRP	2.6
1	A	320	LEU	2.6
1	A	343	GLN	2.5
1	A	394	GLN	2.5
1	A	269	SER	2.5
1	A	168	ILE	2.4
1	A	395	ALA	2.4
1	A	284	ALA	2.4
2	B	44	PRO	2.4
1	A	155	THR	2.3
1	A	364	GLY	2.3
2	B	17	PHE	2.2
1	A	357	ILE	2.2
1	A	354	PHE	2.2
1	A	120	TYR	2.1
1	A	106	VAL	2.1
1	A	206	GLY	2.1
1	A	396	ALA	2.1
1	A	140	VAL	2.1
1	A	370	ALA	2.1
1	A	129	ILE	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	157	VAL	2.1
2	B	18	ASN	2.1
1	A	142	THR	2.0
1	A	298	GLN	2.0
2	B	12	VAL	2.0
2	B	16	LYS	2.0
1	A	232	SER	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](#)

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(Å ²)	Q<0.9
3	CA	A	1007	1/1	0.96	0.04	19,19,19,19	0
4	ZN	B	263	1/1	0.96	0.05	31,31,31,31	0
3	CA	A	1002	1/1	0.97	0.12	14,14,14,14	0
3	CA	A	1001	1/1	0.98	0.03	19,19,19,19	0
3	CA	A	1006	1/1	0.99	0.07	16,16,16,16	0
3	CA	A	1004	1/1	0.99	0.03	16,16,16,16	0
3	CA	A	1005	1/1	0.99	0.10	10,10,10,10	0
3	CA	A	1003	1/1	1.00	0.11	9,9,9,9	0

6.5 Other polymers [i](#)

There are no such residues in this entry.