



Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 1RIQ / pdb_00001riq
Title : The crystal structure of the catalytic fragment of the alanyl-tRNA synthetase
Authors : Swairjo, M.A.; Otero, F.J.; Yang, X.-L.; Lovato, M.A.; Skene, R.J.; McRee, D.E.; Ribas de Pouplana, L.; Schimmel, P.
Deposited on : 2003-11-17
Resolution : 2.14 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
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

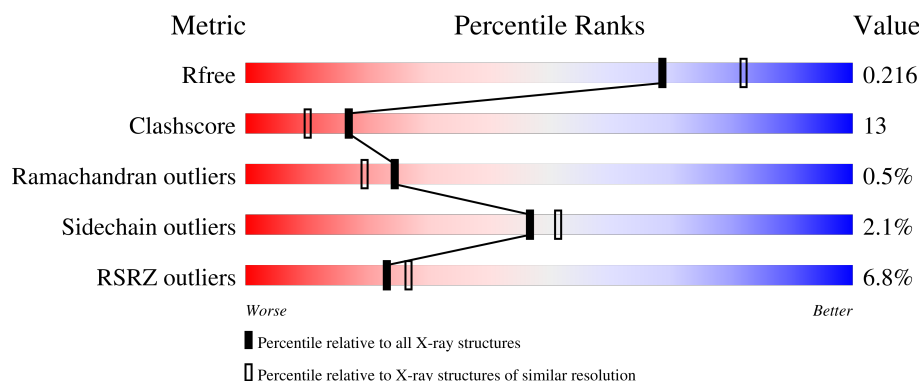
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.14 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	3689 (2.16-2.12)
Clashscore	190562	3812 (2.16-2.12)
Ramachandran outliers	187476	3773 (2.16-2.12)
Sidechain outliers	187428	3772 (2.16-2.12)
RSRZ outliers	180081	3691 (2.16-2.12)

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	465	6% 72% 21% • •

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3977 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 Alanyl-tRNA synthetase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	448	3641	2339	615	675	4	8	0	0	0

There are 19 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	43	MSE	MET	modified residue	UNP O67323
A	92	MSE	MET	modified residue	UNP O67323
A	163	MSE	MET	modified residue	UNP O67323
A	198	MSE	MET	modified residue	UNP O67323
A	220	MSE	MET	modified residue	UNP O67323
A	303	MSE	MET	modified residue	UNP O67323
A	327	MSE	MET	modified residue	UNP O67323
A	360	MSE	MET	modified residue	UNP O67323
A	454	ALA	-	cloning artifact	UNP O67323
A	455	ALA	-	cloning artifact	UNP O67323
A	456	ALA	-	cloning artifact	UNP O67323
A	457	LEU	-	cloning artifact	UNP O67323
A	458	GLU	-	cloning artifact	UNP O67323
A	459	HIS	-	expression tag	UNP O67323
A	460	HIS	-	expression tag	UNP O67323
A	461	HIS	-	expression tag	UNP O67323
A	462	HIS	-	expression tag	UNP O67323
A	463	HIS	-	expression tag	UNP O67323
A	464	HIS	-	expression tag	UNP O67323

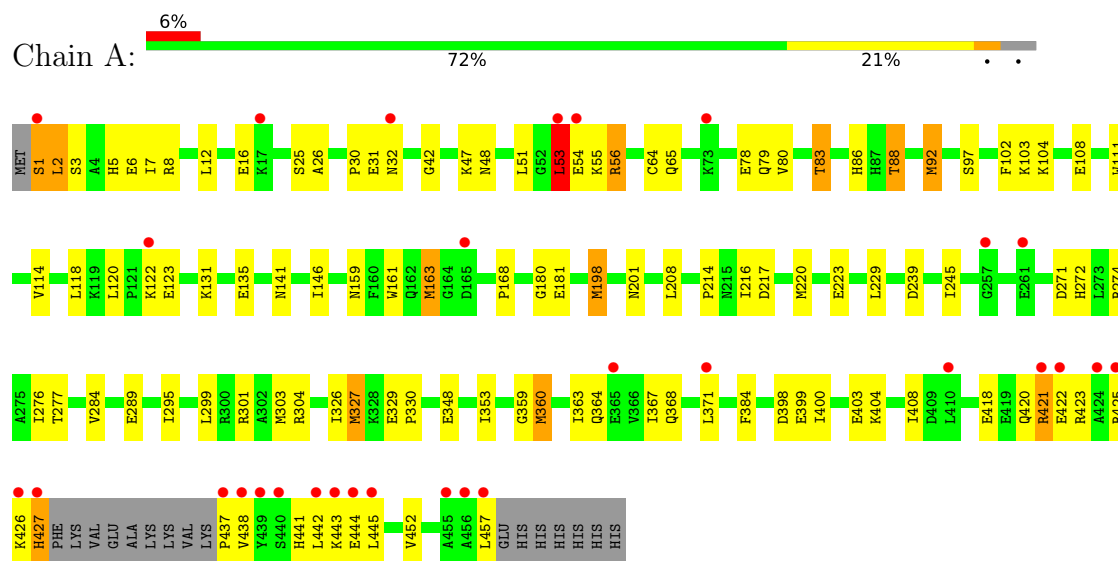
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	336	Total	O	0	0
			336	336		

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: Alanine-tRNA synthetase



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	74.89Å 74.89Å 179.95Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.14 50.00 – 2.14	Depositor EDS
% Data completeness (in resolution range)	100.0 (50.00-2.14) 93.0 (50.00-2.14)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	0.08	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.15 (at 2.10Å)	Xtriage
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.207 , 0.251 0.226 , 0.216	Depositor DCC
R_{free} test set	2822 reflections (9.92%)	wwPDB-VP
Wilson B-factor (Å ²)	26.7	Xtriage
Anisotropy	0.167	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 40.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	3977	wwPDB-VP
Average B, all atoms (Å ²)	34.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.13% 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 [i](#)

5.1 Standard geometry [i](#)

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	0.70	7/3717 (0.2%)	0.90	8/4992 (0.2%)

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	303	MSE	SE-CE	-16.14	1.47	1.95
1	A	327	MSE	SE-CE	-13.04	1.56	1.95
1	A	92	MSE	SE-CE	-10.53	1.63	1.95
1	A	220	MSE	SE-CE	-9.52	1.66	1.95
1	A	198	MSE	SE-CE	-9.01	1.68	1.95
1	A	360	MSE	SE-CE	-6.32	1.76	1.95
1	A	163	MSE	SE-CE	-6.22	1.76	1.95

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	88	THR	N-CA-C	-7.25	100.46	111.56
1	A	180	GLY	N-CA-C	6.98	118.58	111.95
1	A	353	ILE	N-CA-C	6.46	117.14	110.36
1	A	159	ASN	N-CA-C	6.21	120.62	111.87
1	A	245	ILE	N-CA-C	-6.14	104.76	110.53
1	A	103	LYS	N-CA-C	6.12	118.49	111.02
1	A	141	ASN	N-CA-C	5.24	117.07	111.36
1	A	32	ASN	N-CA-C	5.10	116.52	109.54

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	3641	0	3601	92	0
2	A	336	0	0	24	0
All	All	3977	0	3601	92	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 13.

All (92) 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:299:LEU:HD13	1:A:348:GLU:HG2	1.55	0.88
1:A:168:PRO:HB2	1:A:198:MSE:HE3	1.54	0.88
1:A:26:ALA:H	1:A:65:GLN:HE22	1.23	0.85
1:A:452:VAL:HG21	1:A:457:LEU:HD13	1.57	0.84
1:A:5:HIS:HD2	1:A:8:ARG:HH12	1.29	0.80
1:A:368:GLN:NE2	1:A:371:LEU:HD11	1.97	0.79
1:A:326:ILE:HG22	1:A:327:MSE:HE3	1.66	0.76
1:A:181:GLU:H	1:A:181:GLU:CD	1.95	0.74
1:A:289:GLU:HA	2:A:758:HOH:O	1.88	0.73
1:A:329:GLU:HG3	2:A:491:HOH:O	1.91	0.71
1:A:442:LEU:O	1:A:443:LYS:HB2	1.91	0.71
1:A:168:PRO:CB	1:A:198:MSE:HE3	2.21	0.70
1:A:3:SER:OG	1:A:6:GLU:HG3	1.92	0.68
1:A:5:HIS:CD2	1:A:8:ARG:HH12	2.12	0.67
1:A:326:ILE:HG22	1:A:327:MSE:CE	2.23	0.67
1:A:442:LEU:HD23	1:A:443:LYS:N	2.12	0.64
1:A:452:VAL:HG12	2:A:758:HOH:O	1.98	0.63
1:A:31:GLU:N	2:A:698:HOH:O	2.31	0.62
1:A:442:LEU:O	1:A:443:LYS:CB	2.47	0.62
1:A:441:HIS:HB2	1:A:444:GLU:HG3	1.81	0.61
1:A:384:PHE:CZ	1:A:420:GLN:HG3	2.35	0.61
1:A:54:GLU:HG3	2:A:541:HOH:O	2.00	0.61
1:A:78:GLU:HG2	2:A:680:HOH:O	2.02	0.59
1:A:54:GLU:OE2	1:A:56:ARG:NH1	2.36	0.58
1:A:421:ARG:HD2	1:A:425:ARG:NH1	2.19	0.57
1:A:442:LEU:CD2	1:A:443:LYS:HG3	2.35	0.57
1:A:122:LYS:NZ	2:A:748:HOH:O	2.40	0.55
1:A:329:GLU:HB2	1:A:330:PRO:HD3	1.89	0.55
1:A:51:LEU:HB2	1:A:53:LEU:HD22	1.89	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:421:ARG:NH1	1:A:445:LEU:HD11	2.22	0.54
1:A:274:ARG:NE	2:A:546:HOH:O	2.40	0.54
1:A:7:ILE:HD11	1:A:229:LEU:HD12	1.88	0.54
1:A:276:ILE:HG13	1:A:277:THR:N	2.22	0.53
1:A:79:GLN:HG2	2:A:672:HOH:O	2.08	0.53
1:A:135:GLU:HG2	2:A:523:HOH:O	2.08	0.52
1:A:329:GLU:HB2	1:A:330:PRO:CD	2.38	0.52
1:A:442:LEU:HD23	1:A:443:LYS:HG3	1.91	0.52
1:A:111:TRP:CH2	1:A:146:ILE:HD11	2.46	0.51
1:A:422:GLU:HG3	1:A:426:LYS:NZ	2.26	0.51
1:A:97:SER:HB3	1:A:216:ILE:HB	1.93	0.51
1:A:284:VAL:HG11	1:A:295:ILE:HD13	1.93	0.51
1:A:26:ALA:N	1:A:65:GLN:HE22	2.00	0.51
1:A:304:ARG:HD3	1:A:304:ARG:C	2.36	0.50
1:A:3:SER:HB2	2:A:587:HOH:O	2.11	0.50
1:A:131:LYS:HD3	2:A:688:HOH:O	2.11	0.49
1:A:135:GLU:HG2	2:A:632:HOH:O	2.12	0.49
1:A:181:GLU:CD	1:A:181:GLU:N	2.68	0.49
1:A:360:MSE:SE	1:A:400:ILE:HD13	2.62	0.49
1:A:423:ARG:O	1:A:427:HIS:HB3	2.13	0.49
1:A:55:LYS:HA	2:A:690:HOH:O	2.12	0.49
1:A:12:LEU:O	1:A:16:GLU:HG3	2.13	0.48
1:A:104:LYS:O	1:A:108:GLU:HG3	2.13	0.48
1:A:272:HIS:CE1	1:A:301:ARG:HH11	2.30	0.48
1:A:208:LEU:HD11	2:A:711:HOH:O	2.12	0.48
1:A:437:PRO:HA	2:A:566:HOH:O	2.14	0.48
1:A:422:GLU:O	1:A:426:LYS:HG3	2.15	0.47
1:A:289:GLU:HG3	2:A:729:HOH:O	2.14	0.47
1:A:399:GLU:O	1:A:403:GLU:HG3	2.15	0.47
1:A:274:ARG:CZ	2:A:546:HOH:O	2.63	0.47
1:A:30:PRO:HA	2:A:698:HOH:O	2.13	0.46
1:A:418:GLU:CD	1:A:442:LEU:HD21	2.39	0.46
1:A:423:ARG:HG3	1:A:423:ARG:HH11	1.79	0.46
1:A:438:VAL:HG11	1:A:452:VAL:HG11	1.96	0.45
1:A:114:VAL:HG13	1:A:120:LEU:HD12	1.97	0.45
1:A:47:LYS:HE3	1:A:163:MSE:SE	2.67	0.45
1:A:368:GLN:HG3	2:A:639:HOH:O	2.17	0.45
1:A:201:ASN:ND2	2:A:538:HOH:O	2.49	0.45
1:A:359:GLY:O	1:A:363:ILE:HG13	2.16	0.45
1:A:223:GLU:H	1:A:223:GLU:CD	2.25	0.45
1:A:7:ILE:CD1	1:A:229:LEU:HD12	2.47	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:102:PHE:CE1	1:A:214:PRO:HB2	2.51	0.44
1:A:367:ILE:HG21	1:A:404:LYS:HG3	1.99	0.44
1:A:51:LEU:C	1:A:53:LEU:H	2.26	0.44
1:A:80:VAL:HG21	1:A:88:THR:HG23	2.00	0.44
1:A:271:ASP:OD2	1:A:272:HIS:HD2	2.01	0.43
1:A:3:SER:HB2	1:A:239:ASP:OD2	2.18	0.43
1:A:437:PRO:CA	2:A:566:HOH:O	2.66	0.43
1:A:42:GLY:H	1:A:92:MSE:SE	2.52	0.42
1:A:442:LEU:HD22	1:A:443:LYS:HG3	2.00	0.42
1:A:161:TRP:HZ3	1:A:198:MSE:HG2	1.84	0.42
1:A:289:GLU:OE1	1:A:437:PRO:N	2.52	0.42
1:A:25:SER:HB2	1:A:64:CYS:O	2.19	0.42
1:A:118:LEU:HD22	1:A:229:LEU:HD11	2.02	0.42
1:A:398:ASP:HB2	1:A:408:ILE:HD13	2.01	0.42
1:A:421:ARG:NE	2:A:661:HOH:O	2.53	0.41
1:A:51:LEU:CB	1:A:53:LEU:HD22	2.49	0.41
1:A:83:THR:OG1	1:A:86:HIS:HD2	2.04	0.41
1:A:48:ASN:HB3	1:A:54:GLU:HG3	2.02	0.41
1:A:54:GLU:CG	2:A:541:HOH:O	2.66	0.41
1:A:295:ILE:HD12	1:A:295:ILE:N	2.36	0.41
1:A:1:SER:O	1:A:2:LEU:HB2	2.20	0.40
1:A:364:GLN:OE1	1:A:364:GLN:HA	2.21	0.40

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	444/465 (96%)	428 (96%)	14 (3%)	2 (0%)	24 19

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	53	LEU
1	A	2	LEU

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	388/396 (98%)	380 (98%)	8 (2%)	47	51

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	SER
1	A	53	LEU
1	A	56	ARG
1	A	83	THR
1	A	123	GLU
1	A	217	ASP
1	A	421	ARG
1	A	427	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	5	HIS
1	A	65	GLN
1	A	86	HIS
1	A	95	ASN
1	A	159	ASN
1	A	162	GLN
1	A	272	HIS
1	A	368	GLN
1	A	420	GLN
1	A	441	HIS

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	440/465 (94%)	0.56	30 (6%)	23 27	23, 32, 45, 52	0

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	457	LEU	4.8
1	A	1	SER	4.4
1	A	427	HIS	4.2
1	A	424	ALA	3.9
1	A	371	LEU	3.9
1	A	165	ASP	3.8
1	A	444	GLU	3.2
1	A	443	LYS	3.2
1	A	439	TYR	3.1
1	A	442	LEU	3.0
1	A	440	SER	3.0
1	A	456	ALA	3.0
1	A	365	GLU	2.8
1	A	422	GLU	2.8
1	A	455	ALA	2.7
1	A	445	LEU	2.7
1	A	426	LYS	2.7
1	A	421	ARG	2.7
1	A	437	PRO	2.6
1	A	53	LEU	2.6
1	A	438	VAL	2.5
1	A	425	ARG	2.4
1	A	122	LYS	2.2
1	A	17	LYS	2.2
1	A	54	GLU	2.1
1	A	73	LYS	2.1
1	A	257	GLY	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	261	GLU	2.1
1	A	410	LEU	2.1
1	A	32	ASN	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.