



Full wwPDB X-ray Structure Validation Report ⓘ

Nov 5, 2023 – 05:45 PM EST

PDB ID : 5T1Q
Title : 2.15 Angstrom Crystal Structure of N-acetylmuramoyl-L-alanine Amidase from Staphylococcus aureus.
Authors : Minasov, G.; Nocadello, S.; Shuvalova, L.; Kiryukhina, O.; Dubrovska, I.; Bagnoli, F.; Grandi, G.; Anderson, W.F.; Center for Structural Genomics of Infectious Diseases (CSGID)
Deposited on : 2016-08-19
Resolution : 2.15 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.36
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

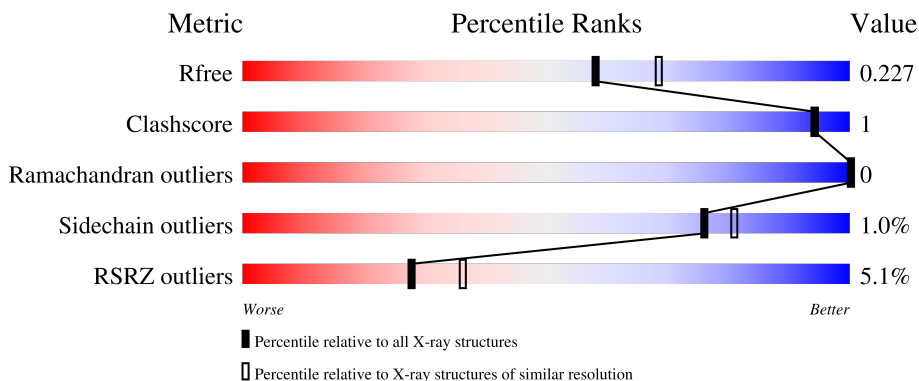
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

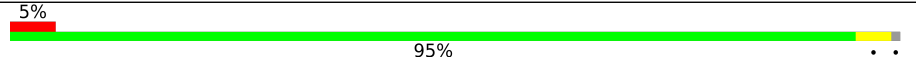
The reported resolution of this entry is 2.15 Å.

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}	130704	1479 (2.16-2.16)
Clashscore	141614	1585 (2.16-2.16)
Ramachandran outliers	138981	1560 (2.16-2.16)
Sidechain outliers	138945	1559 (2.16-2.16)
RSRZ outliers	127900	1456 (2.16-2.16)

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	359	 4% 99%
1	B	359	 5% 95%
1	C	359	 6% 95%
1	D	359	 5% 94% 5%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 12199 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 N-acetylmuramoyl-L-alanine amidase domain-containing protein SAOUHSC_02979.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	358	2873	1784	504	579	1	5	0	4	0
1	B	355	2856	1777	503	570	1	5	0	4	0
1	C	357	2852	1773	501	572	1	5	0	2	0
1	D	353	2813	1751	493	564	1	4	0	1	0

- Molecule 2 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Na	0	0
			2	2		
2	B	1	Total	Na	0	0
			1	1		
2	C	2	Total	Na	0	0
			2	2		
2	D	1	Total	Na	0	0
			1	1		

- Molecule 3 is TRIETHYLENE GLYCOL (three-letter code: PGE) (formula: C₆H₁₄O₄).



Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	C	1	Total	C O	0	0
			10	6 4		

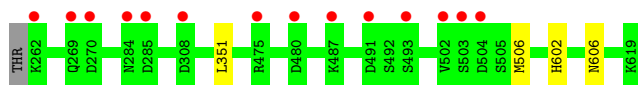
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	211	Total	O	0	3
			213	213		
4	B	217	Total	O	0	4
			221	221		
4	C	181	Total	O	0	1
			181	181		
4	D	171	Total	O	0	3
			174	174		

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.

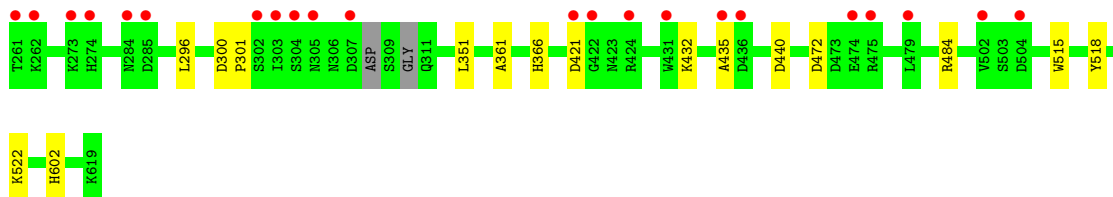
- Molecule 1: N-acetylmuramoyl-L-alanine amidase domain-containing protein SAOUHSC_02979



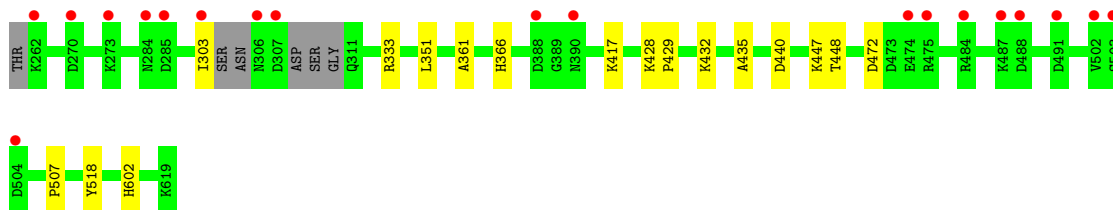
- Molecule 1: N-acetylmuramoyl-L-alanine amidase domain-containing protein SAOUHSC_02979



- Molecule 1: N-acetylmuramoyl-L-alanine amidase domain-containing protein SAOUHSC_02979



- Molecule 1: N-acetylmuramoyl-L-alanine amidase domain-containing protein SAOUHSC_02979



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	63.57Å 66.84Å 102.74Å 108.70° 104.72° 90.25°	Depositor
Resolution (Å)	29.53 – 2.15 29.53 – 2.15	Depositor EDS
% Data completeness (in resolution range)	98.3 (29.53-2.15) 98.3 (29.53-2.15)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.03 (at 2.16Å)	Xtrriage
Refinement program	REFMAC 5.8.0155	Depositor
R, R_{free}	0.173 , 0.219 0.181 , 0.227	Depositor DCC
R_{free} test set	3806 reflections (4.61%)	wwPDB-VP
Wilson B-factor (Å ²)	29.4	Xtrriage
Anisotropy	0.049	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 43.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.016 for -h,k,-k-l	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	12199	wwPDB-VP
Average B, all atoms (Å ²)	41.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.36% 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](#)

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

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	0.45	0/2934	0.65	0/3959
1	B	0.45	0/2916	0.64	0/3932
1	C	0.44	0/2911	0.63	0/3925
1	D	0.45	0/2871	0.65	0/3870
All	All	0.45	0/11632	0.64	0/15686

There are no bond length outliers.

There are no bond angle outliers.

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	2873	0	2719	3	0
1	B	2856	0	2717	10	0
1	C	2852	0	2706	7	0
1	D	2813	0	2672	9	0
2	A	2	0	0	0	0
2	B	1	0	0	0	0
2	C	2	0	0	0	0
2	D	1	0	0	0	0
3	C	10	0	14	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	A	213	0	0	0	0
4	B	221	0	0	2	0
4	C	181	0	0	0	0
4	D	174	0	0	0	0
All	All	12199	0	10828	29	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 1.

All (29) 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:517:VAL:HG12	1:B:521:MSE:HE2	1.59	0.85
1:B:517:VAL:CG1	1:B:521:MSE:HE2	2.27	0.64
1:B:517:VAL:HG12	1:B:521:MSE:CE	2.27	0.64
1:A:506[B]:MSE:O	1:A:506[B]:MSE:CG	2.48	0.60
1:A:506[B]:MSE:O	1:A:506[B]:MSE:HG3	2.02	0.60
1:B:269[B]:GLN:HA	1:B:269[B]:GLN:OE1	2.04	0.57
1:C:435:ALA:HB1	1:C:440:ASP:HB2	1.87	0.56
1:D:303:ILE:H	1:D:303:ILE:HD12	1.78	0.48
1:B:269[B]:GLN:HG2	4:B:869:HOH:O	2.14	0.47
1:B:454:ASN:HD22	1:B:457:LYS:HD2	1.81	0.46
1:B:435:ALA:HB1	1:B:440:ASP:HB2	1.99	0.44
1:D:303:ILE:HD12	1:D:303:ILE:N	2.31	0.44
1:C:518:TYR:CZ	1:C:522:LYS:HE2	2.53	0.44
1:C:351:LEU:HD23	1:C:351:LEU:C	2.38	0.43
1:D:432:LYS:NZ	1:D:472:ASP:O	2.47	0.43
1:D:435:ALA:HB1	1:D:440:ASP:HB2	2.00	0.43
1:D:507:PRO:HG3	1:D:518:TYR:CZ	2.53	0.43
1:B:593:ASN:ND2	4:B:804:HOH:O	2.52	0.43
1:B:521:MSE:HE2	1:B:558:ALA:HB2	2.01	0.42
1:B:507:PRO:HG3	1:B:518:TYR:CZ	2.54	0.42
1:D:351:LEU:C	1:D:351:LEU:HD23	2.39	0.42
1:C:432:LYS:NZ	1:C:472:ASP:O	2.50	0.41
1:C:361:ALA:O	1:C:366:HIS:HA	2.21	0.41
1:C:300:ASP:OD1	1:C:301:PRO:N	2.54	0.41
1:D:428:LYS:HB3	1:D:429:PRO:HD3	2.03	0.41
1:A:351:LEU:C	1:A:351:LEU:HD23	2.41	0.41
1:C:296:LEU:CD1	1:C:515:TRP:CH2	3.04	0.40
1:D:361:ALA:O	1:D:366:HIS:HA	2.21	0.40
1:D:447:LYS:HB2	1:D:448:THR:HG23	2.03	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	360/359 (100%)	353 (98%)	7 (2%)	0	100	100
1	B	355/359 (99%)	349 (98%)	6 (2%)	0	100	100
1	C	354/359 (99%)	345 (98%)	9 (2%)	0	100	100
1	D	348/359 (97%)	342 (98%)	6 (2%)	0	100	100
All	All	1417/1436 (99%)	1389 (98%)	28 (2%)	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	314/307 (102%)	312 (99%)	2 (1%)	86	90
1	B	312/307 (102%)	308 (99%)	4 (1%)	69	74
1	C	312/307 (102%)	309 (99%)	3 (1%)	76	81
1	D	307/307 (100%)	304 (99%)	3 (1%)	76	81
All	All	1245/1228 (101%)	1233 (99%)	12 (1%)	76	81

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	602	HIS
1	A	606	ASN
1	B	436	ASP
1	B	502	VAL
1	B	555	ARG
1	B	602	HIS
1	C	421	ASP
1	C	484	ARG
1	C	602	HIS
1	D	333	ARG
1	D	417	LYS
1	D	602	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	454	ASN
1	B	593	ASN
1	D	378	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](#)

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 7 ligands modelled in this entry, 6 are monoatomic - leaving 1 for Mogul analysis.

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
3	PGE	C	703	-	9,9,9	0.48	0	8,8,8	0.21	0

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
3	PGE	C	703	-	-	3/7/7/7	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	703	PGE	O3-C5-C6-O4
3	C	703	PGE	O2-C3-C4-O3
3	C	703	PGE	O1-C1-C2-O2

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 [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	354/359 (98%)	0.04	14 (3%) 38 47	15, 37, 64, 80	0
1	B	351/359 (97%)	0.09	17 (4%) 30 39	15, 36, 68, 105	0
1	C	353/359 (98%)	0.31	22 (6%) 20 27	15, 44, 86, 104	0
1	D	349/359 (97%)	0.10	19 (5%) 25 34	16, 37, 71, 119	0
All	All	1407/1436 (97%)	0.13	72 (5%) 28 36	15, 38, 74, 119	0

All (72) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	421	ASP	7.5
1	B	502	VAL	6.9
1	C	479	LEU	5.6
1	C	307	ASP	5.5
1	C	422	GLY	5.3
1	D	306	ASN	4.9
1	C	261	THR	4.9
1	D	504	ASP	4.7
1	A	475	ARG	4.5
1	C	262	LYS	4.5
1	B	503	SER	4.4
1	D	502	VAL	4.3
1	D	307	ASP	4.1
1	C	502	VAL	4.1
1	B	261	THR	4.0
1	A	491	ASP	4.0
1	A	284	ASN	3.7
1	D	475	ARG	3.6
1	B	487[A]	LYS	3.6
1	B	306	ASN	3.5
1	C	436	ASP	3.4

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Mol	Chain	Res	Type	RSRZ
1	D	303	ILE	3.4
1	C	474	GLU	3.3
1	C	504	ASP	3.2
1	D	284	ASN	3.2
1	B	273	LYS	3.2
1	D	503	SER	3.2
1	A	269	GLN	3.2
1	B	270	ASP	3.1
1	D	484	ARG	3.1
1	A	502	VAL	3.1
1	C	284	ASN	3.1
1	A	503	SER	3.0
1	B	346	ILE	2.9
1	D	273	LYS	2.9
1	D	474	GLU	2.9
1	B	492	SER	2.9
1	B	269[A]	GLN	2.8
1	A	308	ASP	2.8
1	A	262	LYS	2.8
1	D	285	ASP	2.7
1	C	475	ARG	2.7
1	A	504	ASP	2.6
1	C	303	ILE	2.6
1	B	491	ASP	2.5
1	B	284	ASN	2.5
1	B	390	ASN	2.5
1	C	305	ASN	2.5
1	B	490	ASP	2.5
1	C	302	SER	2.4
1	B	262	LYS	2.4
1	D	491	ASP	2.4
1	A	493	SER	2.4
1	A	480	ASP	2.3
1	D	488	ASP	2.3
1	C	424	ARG	2.3
1	C	435	ALA	2.3
1	D	262	LYS	2.3
1	C	304	SER	2.3
1	A	285	ASP	2.3
1	C	274	HIS	2.3
1	C	273	LYS	2.2
1	D	487	LYS	2.2

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Mol	Chain	Res	Type	RSRZ
1	C	431	TRP	2.2
1	B	303	ILE	2.2
1	C	285	ASP	2.2
1	B	305	ASN	2.1
1	A	487	LYS	2.1
1	A	270	ASP	2.0
1	D	270	ASP	2.0
1	D	390	ASN	2.0
1	D	388	ASP	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 monosaccharides 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	PGE	C	703	10/10	0.73	0.29	63,71,75,75	0
2	NA	C	702	1/1	0.83	0.10	54,54,54,54	0
2	NA	A	702	1/1	0.89	0.17	49,49,49,49	0
2	NA	D	701	1/1	0.94	0.09	27,27,27,27	0
2	NA	B	701	1/1	0.95	0.07	27,27,27,27	0
2	NA	C	701	1/1	0.97	0.08	22,22,22,22	0
2	NA	A	701	1/1	0.98	0.05	25,25,25,25	0

6.5 Other polymers [i](#)

There are no such residues in this entry.