



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 04:18 PM UTC

PDB ID : 3NSJ / pdb_00003nsj
Title : The X-ray crystal structure of lymphocyte perforin
Authors : Law, R.H.; Whisstock, J.C.; Caradoc-Davies, T.T.
Deposited on : 2010-07-01
Resolution : 2.75 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

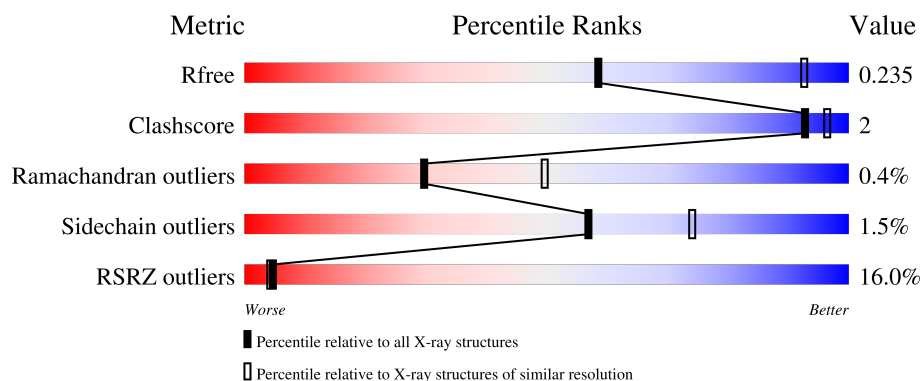
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.75 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	1009 (2.76-2.76)
Clashscore	190562	1044 (2.76-2.76)
Ramachandran outliers	187476	1024 (2.76-2.76)
Sidechain outliers	187428	1024 (2.76-2.76)
RSRZ outliers	180081	1009 (2.76-2.76)

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	540	16% 94%

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
4	IOD	A	713	-	-	X	-

2 Entry composition [i](#)

There are 7 unique types of molecules in this entry. The entry contains 4373 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 Perforin-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	530	4054	2531	747	748	28	0	2	0

There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	213	GLU	ARG	engineered mutation	UNP P10820
A	555	HIS	-	expression tag	UNP P10820
A	556	HIS	-	expression tag	UNP P10820
A	557	HIS	-	expression tag	UNP P10820
A	558	HIS	-	expression tag	UNP P10820
A	559	HIS	-	expression tag	UNP P10820
A	560	HIS	-	expression tag	UNP P10820

- Molecule 2 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 6 3 3	0	0
2	A	1	Total C O 6 3 3	0	0
2	A	1	Total C O 6 3 3	0	0

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

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	2	Total Ca 2 2	0	0

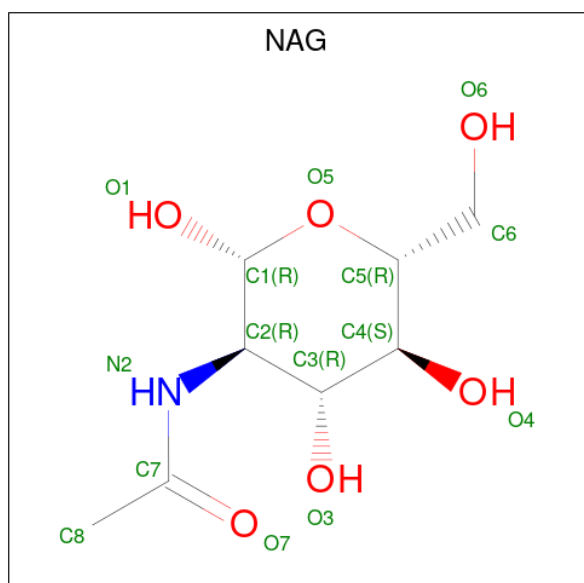
- Molecule 4 is IODIDE ION (CCD ID: IOD) (formula: I).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	4	Total I 4 4	0	0

- Molecule 5 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	2	Total Cl 2 2	0	0

- Molecule 6 is 2-acetamido-2-deoxy-beta-D-glucopyranose (CCD ID: NAG) (formula: C₈H₁₅NO₆).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	A	1	Total	C	N	O	0	0
			14	8	1	5		

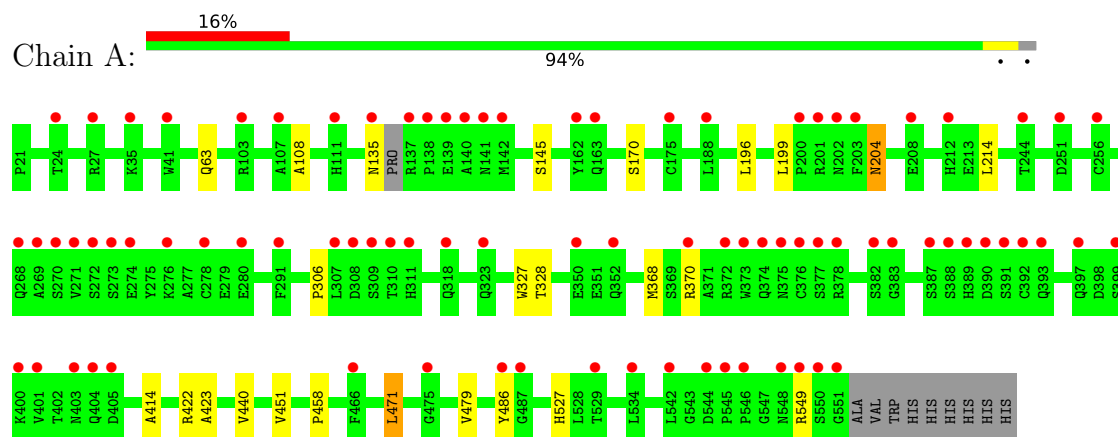
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	279	Total	O	0	0
			279	279		

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: Perforin-1



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	78.64Å 109.80Å 141.03Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.36 – 2.75 47.36 – 2.75	Depositor EDS
% Data completeness (in resolution range)	100.0 (47.36-2.75) 99.8 (47.36-2.75)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	0.11	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.89 (at 2.77Å)	Xtriage
Refinement program	BUSTER-TNT, BUSTER 2.8.0	Depositor
R, R_{free}	0.196 , 0.215 0.210 , 0.235	Depositor DCC
R_{free} test set	1683 reflections (5.20%)	wwPDB-VP
Wilson B-factor (Å ²)	66.9	Xtriage
Anisotropy	0.436	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 67.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	4373	wwPDB-VP
Average B, all atoms (Å ²)	80.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.43% 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: CA, GOL, CL, NAG, IOD

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	0.67	0/4163	1.23	3/5663 (0.1%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	204	ASN	OD1-CG-ND2	-6.74	115.86	122.60
1	A	204	ASN	CB-CG-ND2	5.94	125.31	116.40
1	A	63	GLN	N-CA-C	5.31	118.54	111.75

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	4054	0	3750	12	0
2	A	18	0	24	1	0
3	A	2	0	0	0	0
4	A	4	0	0	2	0
5	A	2	0	0	0	0
6	A	14	0	13	1	0
7	A	279	0	0	0	0
All	All	4373	0	3787	12	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 2.

All (12) 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:204:ASN:HB2	6:A:722:NAG:H83	1.66	0.77
1:A:370:ARG:HA	1:A:549:ARG:HB2	1.89	0.54
1:A:423:ALA:HB3	1:A:458:PRO:HD2	1.90	0.51
1:A:370:ARG:HA	1:A:549:ARG:CB	2.41	0.50
1:A:451:VAL:HG23	2:A:652:GOL:H11	1.94	0.49
1:A:306:PRO:HD2	4:A:713:IOD:I	2.86	0.46
1:A:196:LEU:HA	1:A:199:LEU:HD12	1.99	0.45
1:A:108:ALA:HB3	1:A:170:SER:HB3	2.00	0.44
1:A:327:TRP:HA	4:A:713:IOD:I	2.87	0.44
1:A:368:MET:HA	1:A:368:MET:HE2	2.01	0.41
1:A:440:VAL:HG22	1:A:479:VAL:HG22	2.03	0.41
1:A:414:ALA:HB3	1:A:471:LEU:HD13	2.03	0.40

There are no symmetry-related clashes.

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	528/540 (98%)	504 (96%)	22 (4%)	2 (0%)	30	50

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	486	TYR
1	A	527	HIS

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	411/464 (89%)	405 (98%)	6 (2%)	57 74

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	135	ASN
1	A	145	SER
1	A	214	LEU
1	A	328	THR
1	A	422	ARG
1	A	471	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	61	ASN
1	A	123	ASN
1	A	246	ASN
1	A	299	HIS
1	A	334	ASN
1	A	346	HIS
1	A	361	GLN
1	A	420	ASN
1	A	505	HIS
1	A	521	HIS
1	A	539	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 12 ligands modelled in this entry, 8 are monoatomic - leaving 4 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	$\# Z > 2$
6	NAG	A	722	1	14,14,15	0.97	1 (7%)	17,19,21	0.60	0
2	GOL	A	653	-	5,5,5	0.58	0	5,5,5	0.14	0
2	GOL	A	652	-	5,5,5	0.64	0	5,5,5	0.44	0
2	GOL	A	654	-	5,5,5	0.57	0	5,5,5	0.52	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
6	NAG	A	722	1	-	3/6/23/26	0/1/1/1
2	GOL	A	653	-	-	2/4/4/4	-
2	GOL	A	652	-	-	0/4/4/4	-
2	GOL	A	654	-	-	0/4/4/4	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	A	722	NAG	C1-C2	2.55	1.55	1.52

There are no bond angle outliers.

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	653	GOL	O1-C1-C2-C3
6	A	722	NAG	C8-C7-N2-C2
6	A	722	NAG	O7-C7-N2-C2
6	A	722	NAG	O5-C5-C6-O6
2	A	653	GOL	O1-C1-C2-O2

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	A	722	NAG	1	0
2	A	652	GOL	1	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 ⓘ

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	530/540 (98%)	0.91	85 (16%) 5 4	32, 79, 126, 147	2 (0%)

All (85) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	308	ASP	7.3
1	A	397	GLN	6.2
1	A	551	GLY	6.1
1	A	404	GLN	5.9
1	A	140	ALA	5.5
1	A	310	THR	5.5
1	A	549	ARG	5.2
1	A	41[A]	TRP	4.9
1	A	141	ASN	4.9
1	A	274	GLU	4.9
1	A	550	SER	4.8
1	A	269	ALA	4.6
1	A	378	ARG	4.5
1	A	377	SER	4.4
1	A	135	ASN	4.4
1	A	399	SER	4.3
1	A	318	GLN	4.3
1	A	392	CYS	4.3
1	A	387	SER	4.2
1	A	270	SER	4.2
1	A	390	ASP	4.1
1	A	548	ASN	4.0
1	A	268	GLN	4.0
1	A	391	SER	4.0
1	A	137	ARG	4.0
1	A	375	ASN	3.9
1	A	382	SER	3.8

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	251	ASP	3.5
1	A	272	SER	3.5
1	A	311	HIS	3.3
1	A	487	GLY	3.3
1	A	400	LYS	3.3
1	A	403	ASN	3.3
1	A	271	VAL	3.3
1	A	352	GLN	3.2
1	A	201	ARG	3.1
1	A	309	SER	2.9
1	A	163	GLN	2.9
1	A	278	CYS	2.9
1	A	486	TYR	2.8
1	A	534	LEU	2.8
1	A	393	GLN	2.8
1	A	544	ASP	2.8
1	A	372	ARG	2.7
1	A	291	PHE	2.7
1	A	273	SER	2.6
1	A	162	TYR	2.6
1	A	27	ARG	2.6
1	A	405	ASP	2.5
1	A	374	GLN	2.5
1	A	175	CYS	2.5
1	A	466	PHE	2.5
1	A	373	TRP	2.4
1	A	212[A]	HIS	2.4
1	A	307	LEU	2.4
1	A	200	PRO	2.4
1	A	401	VAL	2.4
1	A	24	THR	2.3
1	A	280	GLU	2.3
1	A	138	PRO	2.3
1	A	545	PRO	2.3
1	A	475	GLY	2.3
1	A	111	HIS	2.3
1	A	388	SER	2.3
1	A	376	CYS	2.3
1	A	208	GLU	2.3
1	A	202	ASN	2.3
1	A	370	ARG	2.3
1	A	244	THR	2.2

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	A	383	GLY	2.2
1	A	529	THR	2.2
1	A	103	ARG	2.2
1	A	203	PHE	2.2
1	A	350	GLU	2.2
1	A	35	LYS	2.2
1	A	276	LYS	2.2
1	A	542	LEU	2.2
1	A	389	HIS	2.2
1	A	107	ALA	2.1
1	A	139	GLU	2.1
1	A	256	CYS	2.1
1	A	188	LEU	2.1
1	A	323	GLN	2.1
1	A	142	MET	2.0
1	A	546	PRO	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
6	NAG	A	722	14/15	0.60	0.23	151,156,160,162	0
2	GOL	A	654	6/6	0.72	0.29	105,106,107,107	0
2	GOL	A	652	6/6	0.79	0.24	92,93,93,94	0
4	IOD	A	711	1/1	0.83	0.22	115,115,115,115	1
2	GOL	A	653	6/6	0.83	0.22	90,91,92,92	0
3	CA	A	701	1/1	0.91	0.06	82,82,82,82	1
5	CL	A	720	1/1	0.94	0.08	82,82,82,82	0

Continued on next page...

Continued from previous page...

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	IOD	A	712	1/1	0.95	0.09	123,123,123,123	1
5	CL	A	721	1/1	0.95	0.08	85,85,85,85	0
4	IOD	A	713	1/1	0.95	0.13	108,108,108,108	1
4	IOD	A	710	1/1	0.96	0.07	146,146,146,146	1
3	CA	A	702	1/1	0.97	0.08	95,95,95,95	0

6.5 Other polymers [i](#)

There are no such residues in this entry.