



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 21, 2023 – 06:31 PM EDT

PDB ID : 2P3Z  
Title : Crystal structure of L-Rhamnonate dehydratase from Salmonella typhimurium  
Authors : Malashkevich, V.N.; Sauder, J.M.; Dickey, M.; Adams, J.M.; Burley, S.K.; Wasserman, S.R.; Gerlt, J.; Almo, S.C.; New York SGX Research Center for Structural Genomics (NYSGXRC)  
Deposited on : 2007-03-10  
Resolution : 1.80 Å(reported)

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We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

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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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Xtriage (Phenix) : 1.13  
EDS : 2.35  
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) : 2.35

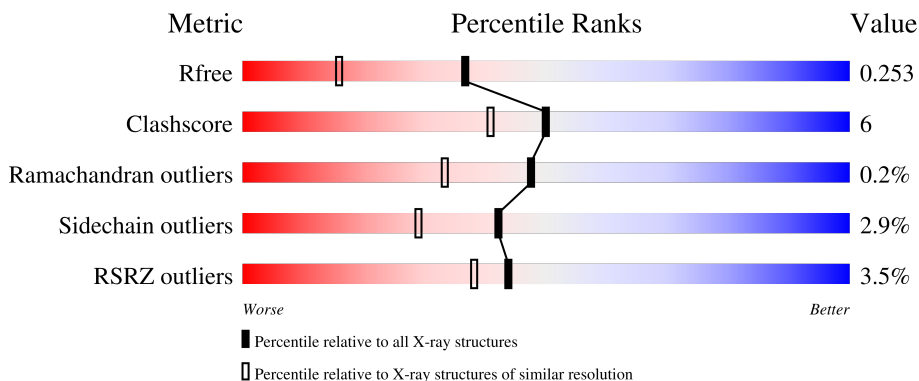
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.80 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	5950 (1.80-1.80)
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)
RSRZ outliers	127900	5850 (1.80-1.80)

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  $\geq 3$ , 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	415	 3% 85% 13% .
1	B	415	 4% 83% 14% ..

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 6970 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 L-rhamnonate dehydratase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	405	3164	2006	550	582	26	0	4	0
1	B	405	3136	1989	543	578	26	0	0	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	MET	-	cloning artifact	UNP Q8ZNF9
A	0	SER	-	cloning artifact	UNP Q8ZNF9
A	1	LEU	-	cloning artifact	UNP Q8ZNF9
A	406	GLU	-	cloning artifact	UNP Q8ZNF9
A	407	GLY	-	cloning artifact	UNP Q8ZNF9
A	408	HIS	-	cloning artifact	UNP Q8ZNF9
A	409	HIS	-	cloning artifact	UNP Q8ZNF9
A	410	HIS	-	cloning artifact	UNP Q8ZNF9
A	411	HIS	-	cloning artifact	UNP Q8ZNF9
A	412	HIS	-	cloning artifact	UNP Q8ZNF9
A	413	HIS	-	cloning artifact	UNP Q8ZNF9
B	-1	MET	-	cloning artifact	UNP Q8ZNF9
B	0	SER	-	cloning artifact	UNP Q8ZNF9
B	1	LEU	-	cloning artifact	UNP Q8ZNF9
B	406	GLU	-	cloning artifact	UNP Q8ZNF9
B	407	GLY	-	cloning artifact	UNP Q8ZNF9
B	408	HIS	-	cloning artifact	UNP Q8ZNF9
B	409	HIS	-	cloning artifact	UNP Q8ZNF9
B	410	HIS	-	cloning artifact	UNP Q8ZNF9
B	411	HIS	-	cloning artifact	UNP Q8ZNF9
B	412	HIS	-	cloning artifact	UNP Q8ZNF9
B	413	HIS	-	cloning artifact	UNP Q8ZNF9

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

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

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	397	Total 397	O 397	0	0
3	B	271	Total 271	O 271	0	0



## 4 Data and refinement statistics

Property	Value	Source
Space group	F 4 3 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	272.25Å 272.25Å 272.25Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.65 – 1.80 19.65 – 1.80	Depositor EDS
% Data completeness (in resolution range)	(Not available) (19.65-1.80) 97.9 (19.65-1.80)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	4.74 (at 1.80Å)	Xtrriage
Refinement program	REFMAC 5.3.0034, SHELX	Depositor
R, $R_{free}$	0.201 , 0.252 0.202 , 0.253	Depositor DCC
$R_{free}$ test set	3873 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	21.7	Xtrriage
Anisotropy	0.000	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 52.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.35$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	6970	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	26.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 51.91 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 5.2469e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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

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	1.12	3/3254 (0.1%)	0.90	3/4407 (0.1%)
1	B	1.00	3/3217 (0.1%)	0.87	0/4359
All	All	1.06	6/6471 (0.1%)	0.89	3/8766 (0.0%)

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	261	GLU	CB-CG	5.72	1.63	1.52
1	B	397	CYS	CB-SG	-5.70	1.72	1.81
1	A	260	TYR	CD2-CE2	5.63	1.47	1.39
1	B	75	GLU	CG-CD	5.34	1.59	1.51
1	B	263	TYR	CE1-CZ	5.12	1.45	1.38
1	A	182	GLU	CG-CD	5.07	1.59	1.51

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	129	SER	CB-CA-C	-6.73	97.31	110.10
1	A	368	LEU	CB-CG-CD1	6.50	122.06	111.00
1	A	393	LEU	CB-CG-CD2	-5.97	100.84	111.00

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	3164	0	3094	35	0
1	B	3136	0	3061	41	1
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	397	0	0	9	0
3	B	271	0	0	5	0
All	All	6970	0	6155	72	1

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 6.

All (72) 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:258:GLN:NE2	1:B:129:SER:HB3	1.54	1.21
1:B:375:VAL:HG23	3:B:679:HOH:O	1.44	1.12
1:A:128:GLY:O	1:A:129:SER:HB2	1.50	1.10
1:A:258:GLN:HE21	1:B:129:SER:CB	1.72	1.00
1:A:258:GLN:HE21	1:B:129:SER:HB3	0.84	1.00
1:A:265:GLU:HG2	3:A:818:HOH:O	1.66	0.94
1:A:303:VAL:HG23	3:A:714:HOH:O	1.69	0.90
1:A:405:HIS:O	1:A:406:GLU:HG2	1.73	0.87
1:A:376:ASN:HB2	3:A:802:HOH:O	1.74	0.86
1:A:395[B]:ARG:HH21	1:A:395[B]:ARG:HG3	1.41	0.86
1:B:167:GLU:OE2	1:B:378:ARG:HD2	1.78	0.82
1:A:395[B]:ARG:HH21	1:A:395[B]:ARG:CG	1.94	0.80
1:A:386:LYS:HE3	3:A:622:HOH:O	1.82	0.78
1:B:302:ASP:OD2	1:B:329:HIS:HD2	1.72	0.73
1:B:14:ARG:NH2	1:B:75:GLU:OE1	2.24	0.69
1:A:14:ARG:NH2	1:A:75:GLU:OE1	2.26	0.68
1:A:128:GLY:O	1:A:129:SER:CB	2.28	0.68
1:A:169:GLN:NE2	3:A:823:HOH:O	2.28	0.66
1:B:79:ARG:HG2	1:B:79:ARG:HH11	1.61	0.65
1:B:351:LEU:HB3	1:B:363:GLN:HE22	1.65	0.62
1:B:369:LEU:HB2	1:B:392:GLU:HB2	1.79	0.62
1:A:302:ASP:OD2	1:A:329:HIS:HD2	1.82	0.61
1:B:367:ILE:HG23	1:B:368:LEU:HD13	1.83	0.61
1:B:11:LYS:HD3	1:B:77:GLU:HG2	1.82	0.61
1:A:302:ASP:OD2	1:A:329:HIS:CD2	2.58	0.56
1:B:196:PRO:HA	1:B:235:TYR:CD1	2.41	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:40:TRP:CD1	1:B:357:CYS:SG	3.00	0.55
1:A:265:GLU:CG	3:A:818:HOH:O	2.39	0.55
1:A:73:GLU:OE2	1:A:395[B]:ARG:NH1	2.41	0.54
1:A:405:HIS:O	1:A:406:GLU:CG	2.50	0.54
1:A:395[B]:ARG:HG3	1:A:395[B]:ARG:NH2	2.18	0.54
1:A:166:ASP:OD1	1:A:381:LYS:NZ	2.40	0.54
1:B:364:PHE:HB2	1:B:368:LEU:HD22	1.92	0.52
1:A:372:PRO:HG3	3:A:590:HOH:O	2.11	0.51
1:B:18:ILE:HD13	1:B:367:ILE:HD13	1.91	0.51
1:A:303:VAL:HG22	1:A:312:LEU:HD22	1.93	0.50
1:B:364:PHE:O	1:B:367:ILE:HG22	2.12	0.49
1:A:330:GLY:HA2	3:A:834:HOH:O	2.13	0.49
1:B:18:ILE:HG12	1:B:69:THR:HB	1.94	0.49
1:B:395:ARG:HD3	3:B:545:HOH:O	2.14	0.48
1:A:244:ALA:N	1:A:245:PRO:CD	2.76	0.48
1:B:32:TYR:CE1	1:B:364:PHE:HE1	2.32	0.48
1:B:40:TRP:CZ3	1:B:174:GLY:HA2	2.49	0.48
1:A:128:GLY:O	1:B:128:GLY:O	2.31	0.47
1:B:375:VAL:HA	3:B:701:HOH:O	2.13	0.47
1:A:351:LEU:HB3	1:A:363:GLN:HE22	1.81	0.46
1:B:40:TRP:CH2	1:B:174:GLY:HA2	2.50	0.46
1:B:244:ALA:N	1:B:245:PRO:CD	2.80	0.45
1:B:25:LYS:NZ	1:B:60:GLN:OE1	2.49	0.45
1:B:375:VAL:CG2	3:B:679:HOH:O	2.26	0.45
1:A:6:THR:HG22	3:A:837:HOH:O	2.17	0.45
1:A:231:GLN:HE21	1:A:236:ALA:HB2	1.82	0.45
1:B:189:LYS:HE3	1:B:226:ASP:HB2	1.99	0.45
1:B:302:ASP:OD2	1:B:329:HIS:CD2	2.61	0.44
1:A:402:PRO:HG2	1:A:403:TYR:CD2	2.52	0.44
1:A:40:TRP:CD1	1:A:357:CYS:SG	3.10	0.44
1:B:303:VAL:HG22	1:B:312:LEU:HD22	1.99	0.43
1:B:1:LEU:HB3	1:B:2:GLU:H	1.76	0.43
1:B:79:ARG:HH11	1:B:79:ARG:CG	2.28	0.43
1:A:196:PRO:HA	1:A:235:TYR:CD1	2.53	0.43
1:B:9:LYS:HD3	3:B:573:HOH:O	2.19	0.42
1:B:155:PRO:HG2	1:B:158:LYS:HG3	2.01	0.42
1:A:39:HIS:ND1	1:A:41:ILE:HG22	2.35	0.42
1:B:194:TRP:NE1	1:B:205:LYS:HD2	2.35	0.41
1:A:340:ILE:HD11	1:A:381:LYS:HB3	2.01	0.41
1:A:112:ILE:HG12	1:A:144:LEU:HB3	2.03	0.41
1:B:167:GLU:OE2	1:B:378:ARG:CD	2.60	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:177:PRO:HD2	1:B:213:MET:CE	2.52	0.40
1:B:67:LEU:O	1:B:89:GLY:HA3	2.21	0.40
1:B:95:ILE:HB	1:B:136:THR:HG21	2.04	0.40
1:B:351:LEU:HB3	1:B:363:GLN:NE2	2.34	0.40
1:B:47:THR:CG2	1:B:59:ARG:HD3	2.52	0.40

All (1) 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:B:376:ASN:ND2	1:B:376:ASN:ND2[22_555]	2.06	0.14

## 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	407/415 (98%)	394 (97%)	12 (3%)	1 (0%)	47	33
1	B	403/415 (97%)	391 (97%)	11 (3%)	1 (0%)	47	33
All	All	810/830 (98%)	785 (97%)	23 (3%)	2 (0%)	47	33

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	88	ALA
1	B	88	ALA

### 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	337/342 (98%)	326 (97%)	11 (3%)	38	23
1	B	333/342 (97%)	324 (97%)	9 (3%)	44	31
All	All	670/684 (98%)	650 (97%)	20 (3%)	42	27

All (20) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	GLU
1	A	3	ASN
1	A	4	ILE
1	A	204[A]	ARG
1	A	204[B]	ARG
1	A	228	TRP
1	A	289	ARG
1	A	366	PRO
1	A	368	LEU
1	A	385	ASP
1	A	400	LYS
1	B	6	THR
1	B	25	LYS
1	B	215	GLU
1	B	224	MET
1	B	228	TRP
1	B	280	GLU
1	B	289	ARG
1	B	368	LEU
1	B	385	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	231	GLN
1	A	258	GLN
1	A	329	HIS
1	B	193	HIS
1	B	329	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 monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 2 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	405/415 (97%)	-0.28	13 (3%) 47 41	10, 20, 37, 56	0
1	B	405/415 (97%)	0.16	15 (3%) 41 36	14, 28, 43, 57	0
All	All	810/830 (97%)	-0.06	28 (3%) 44 38	10, 24, 42, 57	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	406	GLU	5.1
1	A	3	ASN	4.9
1	B	1	LEU	4.3
1	A	24	GLU	4.0
1	A	38	ASN	4.0
1	A	25	LYS	3.8
1	B	37	GLY	3.8
1	B	2	GLU	3.8
1	B	24	GLU	3.7
1	A	37	GLY	3.6
1	B	3	ASN	3.1
1	A	79	ARG	3.0
1	B	398	HIS	3.0
1	B	79	ARG	3.0
1	A	4	ILE	2.8
1	A	36	GLY	2.8
1	B	4	ILE	2.7
1	B	215	GLU	2.7
1	B	38	ASN	2.6
1	A	398	HIS	2.6
1	B	375	VAL	2.6
1	B	36	GLY	2.5
1	A	396	ASP	2.4
1	A	27	ALA	2.3

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Mol	Chain	Res	Type	RSRZ
1	B	53	ARG	2.2
1	B	6	THR	2.1
1	A	23	ALA	2.1
1	B	25	LYS	2.1

## 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
2	NA	A	501	1/1	0.88	0.20	41,41,41,41	0
2	NA	B	501	1/1	0.94	0.11	45,45,45,45	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.