



# Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 3ELQ  
Title : Crystal structure of a bacterial arylsulfate sulfotransferase  
Authors : Malojcic, G.; Owen, R.L.; Grimshaw, J.P.; Glockshuber, R.  
Deposited on : 2008-09-23  
Resolution : 2.00 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](mailto: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>.

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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  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtrriage (Phenix) : 1.20.1  
EDS : 2.37.1  
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) : 2.37.1

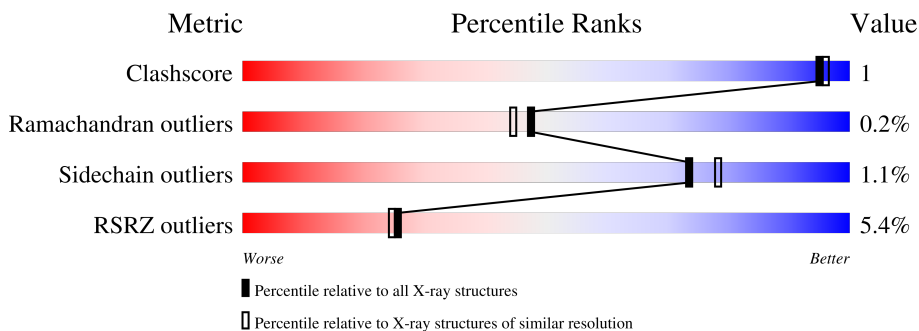
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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))
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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	571	
1	B	571	

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
2	SO4	A	2001	-	-	X	-
3	CL	B	5010	-	-	X	-

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 9997 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 Arylsulfate sulfotransferase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	564	4457	2833	762	852	10	0	3	0
1	B	566	4467	2840	764	853	10	0	2	0

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
2	A	1	5	4	1	0	0
2	A	1	5	4	1	0	0
2	A	1	5	4	1	0	0
2	A	1	5	4	1	0	0

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Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0

- Molecule 3 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	3	Total Cl 3 3	0	0
3	B	5	Total Cl 5 5	0	0

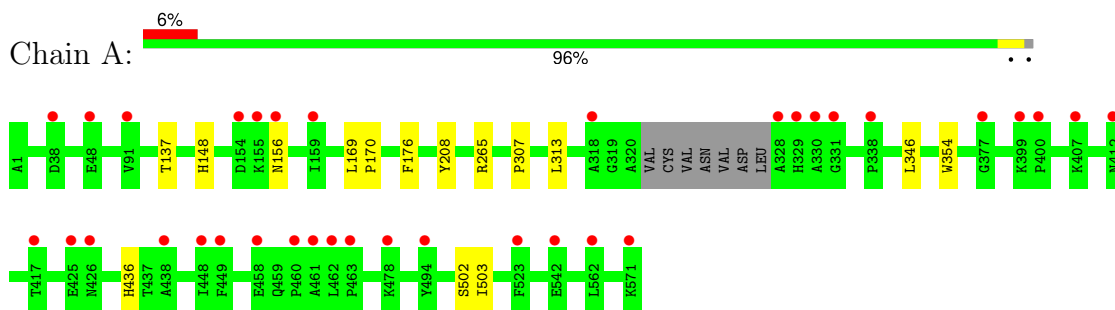
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	509	Total O 509 509	0	0
4	B	501	Total O 501 501	0	0

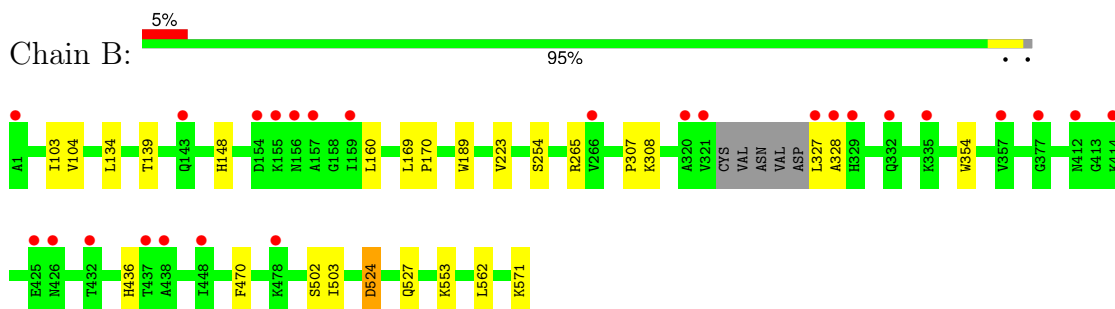
### 3 Residue-property plots [i](#)

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: Arylsulfate sulfotransferase



- Molecule 1: Arylsulfate sulfotransferase



## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 32 1 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	181.73Å 181.73Å 100.43Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	33.90 – 2.00 33.69 – 2.00	Depositor EDS
% Data completeness (in resolution range)	100.0 (33.90-2.00) 97.1 (33.69-2.00)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	0.09	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.84 (at 2.00Å)	Xtrriage
Refinement program	REFMAC 5.3	Depositor
R, $R_{free}$	0.207 , 0.248 0.220 , (Not available)	Depositor DCC
$R_{free}$ test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	34.7	Xtrriage
Anisotropy	0.307	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 47.6	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	0.024 for -h,-k,l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	9997	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	43.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.95% of the height of the origin peak. No significant pseudotranslation is detected.*

<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: CL, SO4

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	0.47	0/4576	0.61	0/6210
1	B	0.46	0/4583	0.61	0/6221
All	All	0.47	0/9159	0.61	0/12431

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	B	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	328	ALA	Peptide

### 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	4457	0	4305	6	0
1	B	4467	0	4324	14	1
2	A	30	0	0	2	0
2	B	25	0	0	1	0
3	A	3	0	0	0	0
3	B	5	0	0	2	0
4	A	509	0	0	0	0
4	B	501	0	0	3	0
All	All	9997	0	8629	21	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 1.

All (21) 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)
3:B:5010:CL:CL	4:B:5444:HOH:O	2.52	0.64
1:B:308:LYS:NZ	3:B:5010:CL:CL	2.69	0.63
1:B:327:LEU:N	4:B:5510:HOH:O	2.38	0.56
1:A:313:LEU:HD22	1:A:346:LEU:HD22	1.91	0.51
1:B:436:HIS:NE2	2:B:2002:SO4:S	2.68	0.51
1:A:169:LEU:N	1:A:170:PRO:CD	2.74	0.51
1:B:169:LEU:N	1:B:170:PRO:CD	2.75	0.49
1:A:307:PRO:HA	1:A:354:TRP:CE3	2.48	0.49
1:B:307:PRO:HA	1:B:354:TRP:CE3	2.48	0.48
1:A:436:HIS:NE2	2:A:2001:SO4:S	2.72	0.48
1:A:436:HIS:NE2	2:A:2001:SO4:O2	2.47	0.47
1:B:524:ASP:HB3	1:B:527:GLN:HB2	1.98	0.45
1:B:571:LYS:NZ	4:B:5465:HOH:O	2.49	0.44
1:A:137:THR:HG23	1:A:176:PHE:HB3	1.99	0.44
1:B:134:LEU:HD22	1:B:562:LEU:HD13	2.00	0.44
1:B:470:PHE:N	1:B:470:PHE:CD1	2.86	0.43
1:B:223:VAL:HG13	1:B:254:SER:HB3	1.99	0.43
1:B:134:LEU:HD23	1:B:134:LEU:C	2.38	0.43
1:B:103:ILE:HG23	1:B:189:TRP:CE2	2.54	0.41
1:B:103:ILE:HG23	1:B:189:TRP:CD2	2.56	0.41
1:B:139:THR:OG1	1:B:553:LYS:NZ	2.53	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:104:VAL:CG2	1:B:104:VAL:CG2[5_555]	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	563/571 (99%)	545 (97%)	17 (3%)	1 (0%)	47 44
1	B	564/571 (99%)	543 (96%)	20 (4%)	1 (0%)	47 44
All	All	1127/1142 (99%)	1088 (96%)	37 (3%)	2 (0%)	47 44

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	502	SER
1	A	502	SER

#### 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	471/483 (98%)	465 (99%)	6 (1%)	69 74
1	B	472/483 (98%)	467 (99%)	5 (1%)	73 78
All	All	943/966 (98%)	932 (99%)	11 (1%)	73 76

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	148	HIS
1	A	156[A]	ASN
1	A	156[B]	ASN
1	A	208	TYR
1	A	265	ARG
1	A	503	ILE
1	B	148	HIS
1	B	160	LEU
1	B	265	ARG
1	B	503	ILE
1	B	524	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 19 ligands modelled in this entry, 8 are monoatomic - leaving 11 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	$\# Z  > 2$
2	SO4	B	2003	-	4,4,4	0.28	0	6,6,6	0.13	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	SO4	B	2008	-	4,4,4	0.26	0	6,6,6	0.16	0
2	SO4	A	2004	-	4,4,4	0.24	0	6,6,6	0.06	0
2	SO4	A	2009	-	4,4,4	0.25	0	6,6,6	0.29	0
2	SO4	A	2001	-	4,4,4	0.21	0	6,6,6	0.33	0
2	SO4	A	2006	-	4,4,4	0.26	0	6,6,6	0.09	0
2	SO4	B	2002	-	4,4,4	0.26	0	6,6,6	0.45	0
2	SO4	B	2010	-	4,4,4	0.27	0	6,6,6	0.16	0
2	SO4	B	2011	-	4,4,4	0.29	0	6,6,6	0.24	0
2	SO4	A	2007	-	4,4,4	0.30	0	6,6,6	0.12	0
2	SO4	A	2005	-	4,4,4	0.25	0	6,6,6	0.26	0

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.

2 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	2001	SO4	2	0
2	B	2002	SO4	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, 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	564/571 (98%)	0.23	35 (6%) 20 19	29, 41, 61, 80	0
1	B	566/571 (99%)	0.24	26 (4%) 32 31	28, 41, 61, 81	0
All	All	1130/1142 (98%)	0.23	61 (5%) 25 24	28, 41, 61, 81	0

All (61) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	329	HIS	5.9
1	B	425	GLU	5.5
1	B	327	LEU	4.9
1	B	426	ASN	4.9
1	B	329	HIS	4.9
1	B	155	LYS	4.7
1	B	154	ASP	4.5
1	B	156	ASN	4.3
1	A	462	LEU	4.3
1	A	331	GLY	4.0
1	A	426	ASN	4.0
1	B	328	ALA	3.8
1	A	155	LYS	3.7
1	A	338	PRO	3.6
1	A	159	ILE	3.3
1	B	159	ILE	3.2
1	A	156[A]	ASN	3.2
1	B	157	ALA	3.0
1	B	1	ALA	3.0
1	A	523	PHE	2.9
1	A	425	GLU	2.9
1	A	562	LEU	2.9
1	A	400	PRO	2.8
1	B	332	GLN	2.8

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Mol	Chain	Res	Type	RSRZ
1	B	143	GLN	2.7
1	A	460	PRO	2.7
1	A	417	THR	2.7
1	B	478	LYS	2.7
1	A	478	LYS	2.6
1	B	321	VAL	2.6
1	B	414	LYS	2.6
1	A	542	GLU	2.6
1	A	318	ALA	2.6
1	A	463	PRO	2.6
1	B	412	ASN	2.5
1	A	407	LYS	2.5
1	B	320	ALA	2.5
1	A	377	GLY	2.5
1	A	399	LYS	2.5
1	A	412	ASN	2.5
1	A	494	TYR	2.5
1	A	48	GLU	2.3
1	B	448	ILE	2.3
1	A	154	ASP	2.3
1	B	437	THR	2.3
1	A	571	LYS	2.2
1	A	448	ILE	2.2
1	B	335	LYS	2.2
1	B	377	GLY	2.2
1	A	330	ALA	2.2
1	A	461	ALA	2.2
1	B	432	THR	2.2
1	B	266	VAL	2.1
1	A	91	VAL	2.1
1	B	357	VAL	2.1
1	A	38[A]	ASP	2.1
1	A	438	ALA	2.1
1	A	328	ALA	2.1
1	B	438	ALA	2.1
1	A	458	GLU	2.0
1	A	449	PHE	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains

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( $\text{\AA}^2$ )	Q<0.9
3	CL	B	5009	1/1	0.59	0.14	81,81,81,81	0
2	SO4	B	2011	5/5	0.75	0.27	93,93,94,94	0
3	CL	B	5007	1/1	0.82	0.13	69,69,69,69	0
2	SO4	A	2009	5/5	0.85	0.27	84,85,86,87	0
2	SO4	A	2004	5/5	0.87	0.30	106,106,106,107	0
2	SO4	A	2007	5/5	0.87	0.32	87,88,88,89	0
2	SO4	B	2010	5/5	0.91	0.28	87,88,88,88	0
2	SO4	A	2005	5/5	0.92	0.24	83,83,83,84	0
3	CL	A	5008	1/1	0.93	0.07	58,58,58,58	0
3	CL	B	5010	1/1	0.94	0.08	50,50,50,50	0
2	SO4	B	2008	5/5	0.95	0.16	80,80,80,80	0
3	CL	A	5004	1/1	0.95	0.18	66,66,66,66	0
2	SO4	B	2002	5/5	0.96	0.14	42,43,44,46	0
2	SO4	A	2006	5/5	0.96	0.18	63,63,63,64	0
3	CL	B	5006	1/1	0.96	0.08	40,40,40,40	0
2	SO4	B	2003	5/5	0.97	0.10	66,67,67,67	0
2	SO4	A	2001	5/5	0.97	0.12	43,43,44,45	0
3	CL	B	5001	1/1	0.98	0.05	45,45,45,45	0
3	CL	A	5002	1/1	0.99	0.05	43,43,43,43	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.