



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 26, 2026 – 05:14 PM UTC

PDB ID : 4OT2 / pdb_00004ot2
Title : Crystal Structure of Equine Serum Albumin in complex with Naproxen
Authors : Sekula, B.; Bujacz, A.; Zielinski, K.; Bujacz, G.
Deposited on : 2014-02-13
Resolution : 2.42 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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

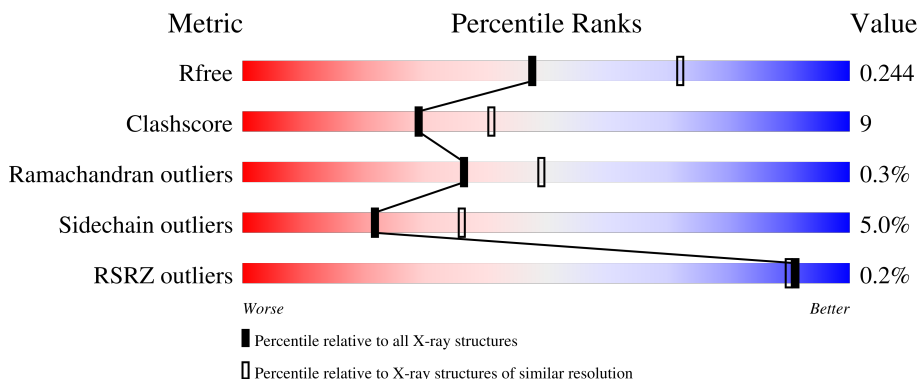
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION


The reported resolution of this entry is 2.42 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	6062 (2.44-2.40)
Clashscore	190562	6562 (2.44-2.40)
Ramachandran outliers	187476	6481 (2.44-2.40)
Sidechain outliers	187428	6482 (2.44-2.40)
RSRZ outliers	180081	6066 (2.44-2.40)

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	583	 76% 22% ..

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	ACT	A	604	-	-	X	-

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
5	MLI	A	608	-	-	X	-

2 Entry composition [i](#)

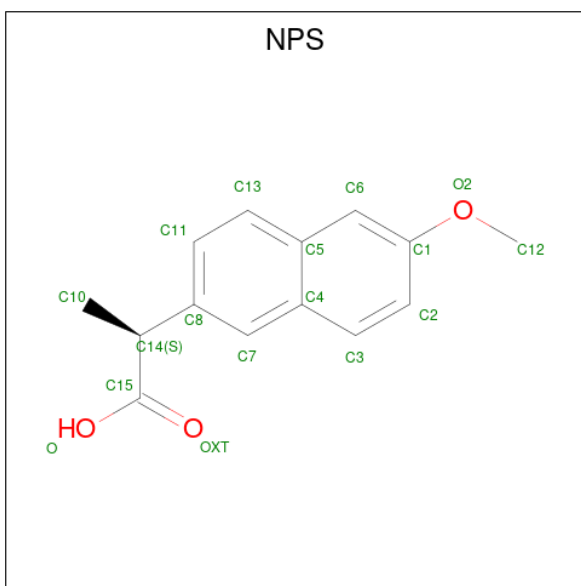
There are 6 unique types of molecules in this entry. The entry contains 4789 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Serum albumin.

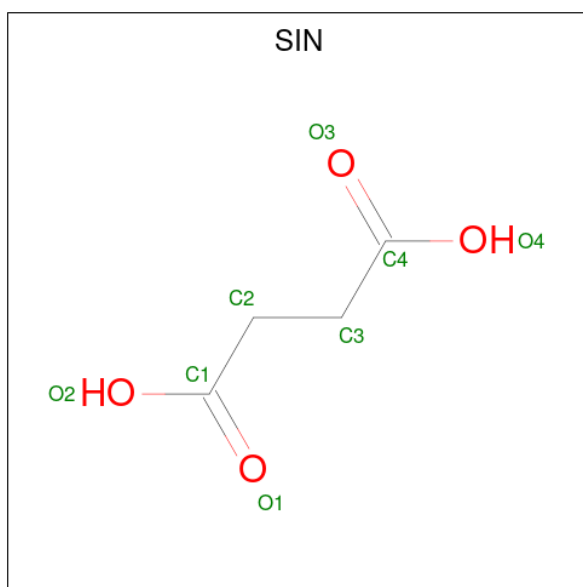
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	580	4601	2910	774	882	35	0	3	0

- Molecule 2 is (2S)-2-(6-methoxynaphthalen-2-yl)propanoic acid (CCD ID: NPS) (formula: C₁₄H₁₄O₃).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	17	14	3	0	0
2	A	1	17	14	3	0	0

- Molecule 3 is SUCCINIC ACID (CCD ID: SIN) (formula: C₄H₆O₄).



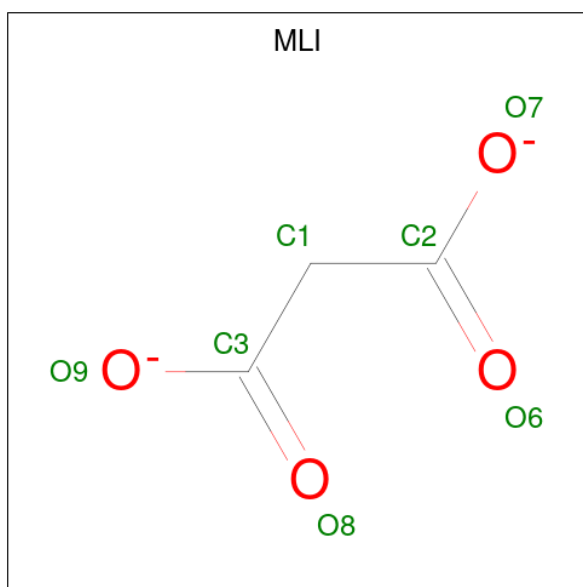
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			8	4	4		

- Molecule 4 is ACETATE ION (CCD ID: ACT) (formula: $C_2H_3O_2^-$).



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

- Molecule 5 is MALONATE ION (CCD ID: MLI) (formula: $C_3H_2O_4^-$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total C O 7 3 4	0	0
5	A	1	Total C O 7 3 4	0	0
5	A	1	Total C O 7 3 4	0	0
5	A	1	Total C O 7 3 4	0	0

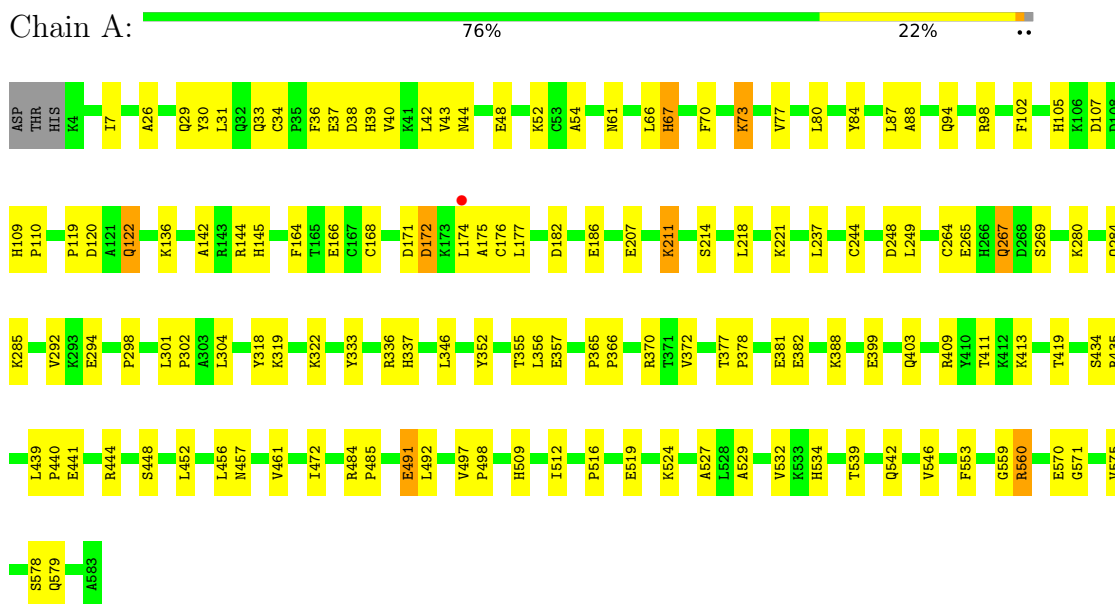
- Molecule 6 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	110	Total O 110 110	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: Serum albumin



4 Data and refinement statistics i

Property	Value	Source
Space group	P 61	Depositor
Cell constants a, b, c, α , β , γ	93.77Å 93.77Å 142.41Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	50.00 – 2.42 50.00 – 2.42	Depositor EDS
% Data completeness (in resolution range)	98.8 (50.00-2.42) 98.8 (50.00-2.42)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.08	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.26 (at 2.42Å)	Xtrriage
Refinement program	REFMAC 5.8.0049	Depositor
R, R_{free}	0.179 , 0.247 0.180 , 0.244	Depositor DCC
R_{free} test set	1084 reflections (4.01%)	wwPDB-VP
Wilson B-factor (Å ²)	48.5	Xtrriage
Anisotropy	0.017	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 43.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.055 for h,-h-k,-l	Xtrriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	4789	wwPDB-VP
Average B, all atoms (Å ²)	59.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.87% 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: SIN, NPS, ACT, MLI

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	0.93	1/4709 (0.0%)	1.12	11/6353 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	109	HIS	N-CA	-5.30	1.41	1.46

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	207	GLU	N-CA-C	5.88	118.17	111.11
1	A	527	ALA	N-CA-C	-5.80	104.96	111.28
1	A	249	LEU	N-CA-C	5.61	117.47	111.36
1	A	176	CYS	N-CA-C	-5.53	104.76	112.45
1	A	168	CYS	CA-C-N	-5.52	112.94	119.84

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	4601	0	4523	79	0
2	A	34	0	26	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	8	0	4	2	0
4	A	8	0	6	2	0
5	A	28	0	8	2	0
6	A	110	0	0	3	0
All	All	4789	0	4567	80	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 9.

The worst 5 of 80 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:119:PRO:HG2	1:A:174:LEU:HG	1.30	1.13
1:A:484:ARG:HB3	1:A:485:PRO:HD3	1.63	0.80
1:A:119:PRO:HB3	1:A:177:LEU:HD23	1.68	0.76
1:A:66:LEU:HB3	1:A:70:PHE:CE2	2.23	0.73
1:A:44:ASN:O	1:A:48:GLU:HG3	1.89	0.72

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	581/583 (100%)	555 (96%)	24 (4%)	2 (0%)	36 49

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	171	ASP
1	A	61	ASN

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	508/508 (100%)	483 (95%)	25 (5%)	22 37

5 of 25 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	214	SER
1	A	267	GLN
1	A	560	ARG
1	A	265	GLU
1	A	269	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 7 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	266	HIS
1	A	267	GLN
1	A	579	GLN
1	A	317	HIS
1	A	145	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

9 ligands are modelled in this entry.

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
5	MLI	A	608	-	6,6,6	1.37	0	7,7,7	1.06	0
2	NPS	A	602	-	18,18,18	2.00	7 (38%)	25,25,25	1.64	4 (16%)
5	MLI	A	606	-	6,6,6	1.84	3 (50%)	7,7,7	0.96	0
5	MLI	A	607	-	6,6,6	1.61	1 (16%)	7,7,7	1.29	1 (14%)
2	NPS	A	601	-	18,18,18	1.45	2 (11%)	25,25,25	1.46	3 (12%)
5	MLI	A	609	-	6,6,6	1.72	1 (16%)	7,7,7	1.49	1 (14%)
4	ACT	A	605	-	3,3,3	0.93	0	3,3,3	0.87	0
3	SIN	A	603	-	7,7,7	1.31	1 (14%)	8,8,8	1.17	1 (12%)
4	ACT	A	604	-	3,3,3	0.88	0	3,3,3	1.09	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
5	MLI	A	608	-	-	0/4/4/4	-
2	NPS	A	602	-	-	6/10/10/10	0/2/2/2
5	MLI	A	606	-	-	0/4/4/4	-
5	MLI	A	607	-	-	2/4/4/4	-
2	NPS	A	601	-	-	2/10/10/10	0/2/2/2
5	MLI	A	609	-	-	2/4/4/4	-
3	SIN	A	603	-	-	2/5/5/5	-

The worst 5 of 15 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	602	NPS	C5-C4	5.07	1.53	1.42
2	A	602	NPS	C6-C1	3.44	1.43	1.37

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	601	NPS	C5-C4	3.28	1.49	1.42
5	A	609	MLI	C1-C3	2.95	1.55	1.51
5	A	606	MLI	C1-C2	2.75	1.55	1.51

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	602	NPS	C8-C14-C15	4.37	121.22	108.75
2	A	601	NPS	C8-C14-C15	4.07	120.36	108.75
2	A	601	NPS	C12-O2-C1	3.63	125.28	117.50
2	A	601	NPS	C10-C14-C8	-3.15	105.01	112.92
2	A	602	NPS	C3-C2-C1	2.92	123.92	120.13

There are no chirality outliers.

5 of 14 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	602	NPS	C6-C1-O2-C12
2	A	602	NPS	C2-C1-O2-C12
2	A	601	NPS	C8-C14-C15-O
2	A	601	NPS	C8-C14-C15-OXT
2	A	602	NPS	C8-C14-C15-OXT

There are no ring outliers.

4 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	608	MLI	2	0
2	A	602	NPS	1	0
3	A	603	SIN	2	0
4	A	604	ACT	2	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 [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	580/583 (99%)	-0.47	1 (0%) 91 90	32, 55, 91, 137	3 (0%)

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	174	LEU	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
5	MLI	A	608	7/7	0.81	0.11	66,74,76,82	0
5	MLI	A	606	7/7	0.83	0.13	61,67,74,76	0
4	ACT	A	605	4/4	0.84	0.16	66,74,75,79	0
2	NPS	A	602	17/17	0.87	0.14	63,73,83,85	0
4	ACT	A	604	4/4	0.88	0.15	64,66,71,72	0
5	MLI	A	607	7/7	0.91	0.10	68,70,77,78	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
5	MLI	A	609	7/7	0.93	0.09	55,61,71,77	0
2	NPS	A	601	17/17	0.96	0.07	38,44,51,55	0
3	SIN	A	603	8/8	0.96	0.08	49,52,61,62	0

6.5 Other polymers [i](#)

There are no such residues in this entry.