



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:00 PM UTC

PDB ID : 5WT2 / pdb_00005wt2
Title : NifS from Helicobacter pylori
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Deposited on : 2016-12-09
Resolution : 2.30 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)
Xtrriage (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

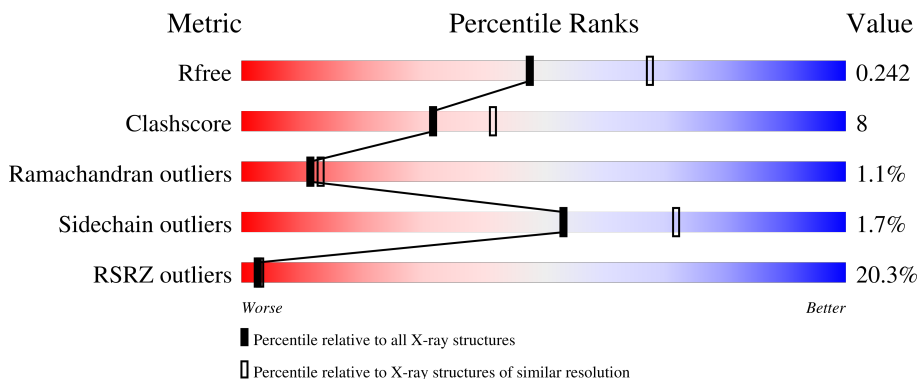
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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	401	

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 2838 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 Cysteine desulfurase IscS.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	355	2745	1735	479	520	11	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

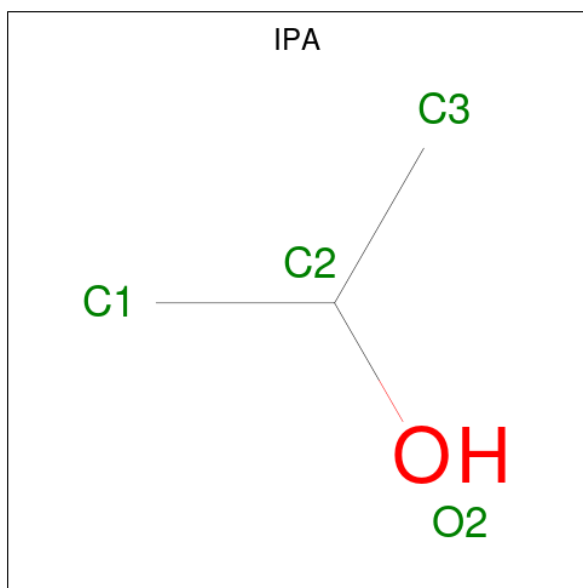
Chain	Residue	Modelled	Actual	Comment	Reference
A	2	VAL	LEU	engineered mutation	UNP O25008
A	138	ARG	LYS	engineered mutation	UNP O25008
A	388	VAL	-	expression tag	UNP O25008
A	389	ASP	-	expression tag	UNP O25008
A	390	LEU	-	expression tag	UNP O25008
A	391	VAL	-	expression tag	UNP O25008
A	392	PRO	-	expression tag	UNP O25008
A	393	ARG	-	expression tag	UNP O25008
A	394	GLY	-	expression tag	UNP O25008
A	395	SER	-	expression tag	UNP O25008
A	396	HIS	-	expression tag	UNP O25008
A	397	HIS	-	expression tag	UNP O25008
A	398	HIS	-	expression tag	UNP O25008
A	399	HIS	-	expression tag	UNP O25008
A	400	HIS	-	expression tag	UNP O25008
A	401	HIS	-	expression tag	UNP O25008

- Molecule 2 is PYRIDOXAL-5'-PHOSPHATE (CCD ID: PLP) (formula: C₈H₁₀NO₆P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	P		
2	A	1	15	8	1	5	1	0	0

- Molecule 3 is ISOPROPYL ALCOHOL (CCD ID: IPA) (formula: C₃H₈O).



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

- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total Cl 1 1	0	0

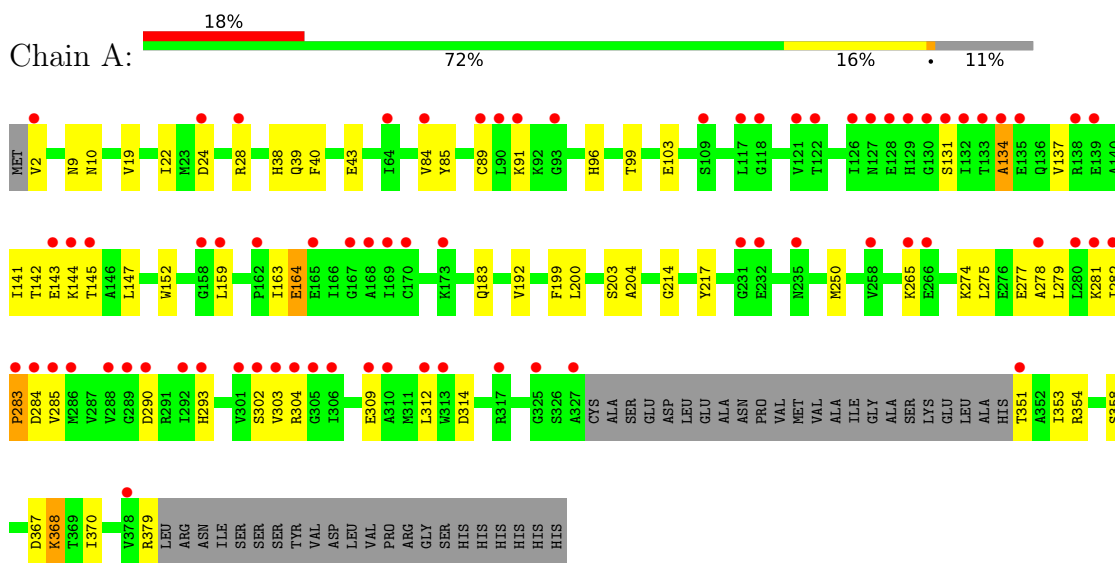
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	73	Total O 73 73	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: Cysteine desulfurase IscS



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 21 2	Depositor
Cell constants a, b, c, α , β , γ	103.01Å 103.01Å 133.65Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	43.55 – 2.30 43.55 – 2.30	Depositor EDS
% Data completeness (in resolution range)	98.5 (43.55-2.30) 98.5 (43.55-2.30)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.41 (at 2.29Å)	Xtrriage
Refinement program	PHENIX 1.11.1_2575	Depositor
R, R_{free}	0.215 , 0.239 0.218 , 0.242	Depositor DCC
R_{free} test set	1628 reflections (4.93%)	wwPDB-VP
Wilson B-factor (Å ²)	48.9	Xtrriage
Anisotropy	0.017	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 68.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2838	wwPDB-VP
Average B, all atoms (Å ²)	81.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.35% 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: CL, IPA, PLP

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	0.15	0/2795	0.40	0/3786

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	2745	0	2755	45	0
2	A	15	0	7	1	0
3	A	4	0	8	0	0
4	A	1	0	0	0	0
5	A	73	0	0	0	0
All	All	2838	0	2770	45	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 8.

All (45) 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:39:GLN:O	1:A:43:GLU:HB2	1.70	0.91
1:A:96:HIS:HD1	1:A:145:THR:HG22	1.45	0.81
1:A:282:ILE:HB	1:A:283:PRO:HD2	1.73	0.70
1:A:285:VAL:HA	1:A:302:SER:O	1.96	0.64
1:A:141:ILE:HA	1:A:145:THR:HG21	1.80	0.63
1:A:137:VAL:O	1:A:141:ILE:HG13	1.99	0.62
1:A:204:ALA:HB2	1:A:250:MET:HE3	1.83	0.60
1:A:10:ASN:HB2	1:A:354:ARG:HH21	1.68	0.58
1:A:96:HIS:ND1	1:A:145:THR:HG22	2.15	0.58
1:A:38:HIS:CE1	1:A:40:PHE:HB2	2.40	0.56
1:A:163:ILE:O	1:A:164:GLU:HB2	2.05	0.56
1:A:9:ASN:CG	1:A:358:SER:HB3	2.31	0.55
1:A:159:LEU:HD21	1:A:290:ASP:HB3	1.90	0.54
1:A:312:LEU:HD21	1:A:353:ILE:HG23	1.91	0.53
1:A:214:GLY:HA2	1:A:250:MET:HE1	1.92	0.52
1:A:274:LYS:NZ	1:A:367:ASP:OD1	2.45	0.50
1:A:278:ALA:HA	1:A:281:LYS:HE2	1.94	0.50
1:A:199:PHE:HA	1:A:217:TYR:O	2.11	0.49
1:A:134:ALA:O	1:A:137:VAL:HG22	2.11	0.48
1:A:142:THR:OG1	1:A:144:LYS:HG2	2.14	0.48
1:A:152:TRP:HA	1:A:163:ILE:HG13	1.96	0.47
1:A:283:PRO:HB2	1:A:284:ASP:H	1.52	0.47
1:A:285:VAL:HG12	1:A:303:VAL:HG22	2.00	0.44
1:A:192:VAL:HG12	1:A:200:LEU:HD13	1.98	0.44
1:A:143:GLU:CD	1:A:143:GLU:H	2.25	0.44
1:A:183:GLN:HE21	2:A:501:PLP:HO3	1.61	0.44
1:A:279:LEU:O	1:A:282:ILE:HG12	2.18	0.44
1:A:282:ILE:O	1:A:285:VAL:HG22	2.18	0.43
1:A:368:LYS:HD3	1:A:368:LYS:HA	1.75	0.43
1:A:24:ASP:HB3	1:A:28:ARG:NH2	2.33	0.43
1:A:10:ASN:HB2	1:A:354:ARG:NH2	2.33	0.43
1:A:309:GLU:OE2	1:A:351:THR:OG1	2.28	0.43
1:A:314:ASP:CG	1:A:379:ARG:HH21	2.26	0.43
1:A:85:TYR:O	1:A:89:CYS:HB2	2.19	0.42
1:A:84:VAL:HG21	1:A:147:LEU:HD22	2.01	0.42
1:A:265:LYS:HA	1:A:265:LYS:HD2	1.84	0.42
1:A:19:VAL:O	1:A:22:ILE:HG22	2.19	0.42
1:A:99:THR:OG1	1:A:103:GLU:HG3	2.19	0.42
1:A:367:ASP:HA	1:A:370:ILE:HD12	2.01	0.42
1:A:275:LEU:O	1:A:279:LEU:HG	2.20	0.42
1:A:285:VAL:HG12	1:A:303:VAL:HA	2.01	0.42
1:A:24:ASP:HB3	1:A:28:ARG:HH21	1.85	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:91:LYS:HB3	1:A:91:LYS:HE2	1.86	0.41
1:A:163:ILE:O	1:A:164:GLU:CB	2.69	0.41
1:A:290:ASP:OD2	1:A:293:HIS:ND1	2.54	0.41

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	351/401 (88%)	337 (96%)	10 (3%)	4 (1%)	11 13

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	164	GLU
1	A	283	PRO
1	A	134	ALA
1	A	304	ARG

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	298/337 (88%)	293 (98%)	5 (2%)	53 72

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	2	VAL
1	A	131	SER
1	A	203	SER
1	A	277	GLU
1	A	368	LYS

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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 1 is monoatomic - leaving 2 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	IPA	A	502	-	3,3,3	0.59	0	3,3,3	0.32	0
2	PLP	A	501	1	15,15,16	1.58	2 (13%)	21,22,23	1.07	2 (9%)

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
2	PLP	A	501	1	-	1/6/6/8	0/1/1/1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	501	PLP	C5-C4	-3.76	1.36	1.40
2	A	501	PLP	C3-C4	-2.14	1.36	1.40

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	501	PLP	C5-C6-N1	-2.38	119.96	123.83
2	A	501	PLP	C6-C5-C4	2.29	119.97	118.10

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	501	PLP	C5A-O4P-P-O3P

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	501	PLP	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	355/401 (88%)	1.09	72 (20%) 3 3	38, 78, 135, 192	0

All (72) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	306	ILE	6.6
1	A	286	MET	6.2
1	A	128	GLU	4.8
1	A	303	VAL	4.7
1	A	283	PRO	4.4
1	A	265	LYS	4.2
1	A	2	VAL	4.2
1	A	327	ALA	4.2
1	A	313	TRP	4.1
1	A	280	LEU	3.9
1	A	285	VAL	3.8
1	A	129	HIS	3.7
1	A	292	ILE	3.6
1	A	235	ASN	3.5
1	A	145	THR	3.4
1	A	378	VAL	3.4
1	A	169	ILE	3.2
1	A	144	LYS	3.2
1	A	232	GLU	3.2
1	A	127	ASN	3.2
1	A	109	SER	3.2
1	A	84	VAL	3.2
1	A	302	SER	3.1
1	A	126	ILE	3.0
1	A	281	LYS	3.0
1	A	159	LEU	3.0
1	A	170	CYS	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	290	ASP	2.9
1	A	133	THR	2.8
1	A	325	GLY	2.8
1	A	121	VAL	2.8
1	A	91	LYS	2.8
1	A	132	ILE	2.8
1	A	231	GLY	2.8
1	A	28	ARG	2.7
1	A	134	ALA	2.7
1	A	289	GLY	2.7
1	A	304	ARG	2.6
1	A	135	GLU	2.6
1	A	89	CYS	2.6
1	A	258	VAL	2.6
1	A	64	ILE	2.5
1	A	310	ALA	2.5
1	A	122	THR	2.5
1	A	167	GLY	2.5
1	A	317	ARG	2.4
1	A	266	GLU	2.4
1	A	118	GLY	2.4
1	A	93	GLY	2.4
1	A	131	SER	2.4
1	A	284	ASP	2.3
1	A	301	VAL	2.3
1	A	139	GLU	2.3
1	A	130	GLY	2.3
1	A	168	ALA	2.3
1	A	138	ARG	2.2
1	A	143	GLU	2.2
1	A	90	LEU	2.2
1	A	162	PRO	2.2
1	A	305	GLY	2.2
1	A	278	ALA	2.2
1	A	293	HIS	2.2
1	A	282	ILE	2.1
1	A	158	GLY	2.1
1	A	173	LYS	2.1
1	A	288	VAL	2.1
1	A	351	THR	2.1
1	A	312	LEU	2.1
1	A	24	ASP	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	309	GLU	2.0
1	A	165	GLU	2.0
1	A	117	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
3	IPA	A	502	4/4	0.86	0.29	65,65,67,72	0
4	CL	A	503	1/1	0.89	0.18	77,77,77,77	0
2	PLP	A	501	15/16	0.97	0.10	35,54,68,69	0

6.5 Other polymers [i](#)

There are no such residues in this entry.