



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 05:08 PM UTC

PDB ID : 2F26 / pdb_00002f26
Title : Crystal Structure of the Human Sialidase Neu2 E111Q-Q112E Double Mutant
Authors : Chavas, L.M.G.; Kato, R.; Fusi, P.; Tringali, C.; Venerando, B.; Tettamanti, G.; Monti, E.; Wakatsuki, S.
Deposited on : 2005-11-15
Resolution : 1.58 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
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

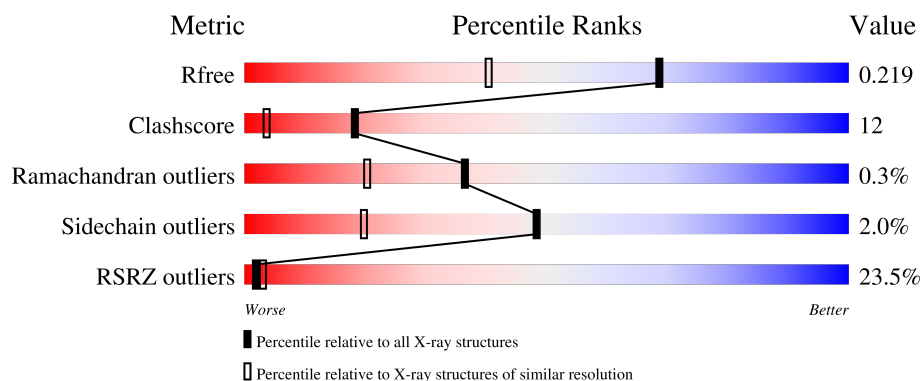
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.58 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	1094 (1.58-1.58)
Clashscore	190562	1105 (1.58-1.58)
Ramachandran outliers	187476	1082 (1.58-1.58)
Sidechain outliers	187428	1081 (1.58-1.58)
RSRZ outliers	180081	1094 (1.58-1.58)

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	382	22% 80% 13% 5%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 3133 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 Sialidase 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	362	Total	C	N	O	S	0	6	0
			2861	1810	510	528	13			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	cloning artifact	UNP Q9Y3R4
A	0	SER	-	cloning artifact	UNP Q9Y3R4
A	111	GLN	GLU	engineered mutation	UNP Q9Y3R4
A	112	GLU	GLN	engineered mutation	UNP Q9Y3R4

- Molecule 2 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

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

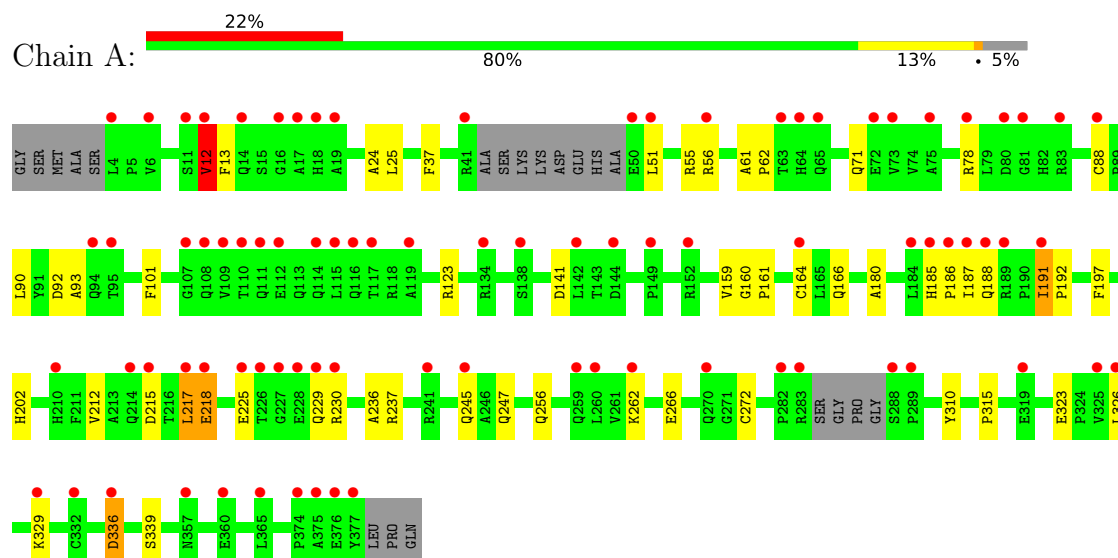
- Molecule 3 is water.

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

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: Sialidase 2



4 Data and refinement statistics

Property	Value	Source
Space group	H 3	Depositor
Cell constants a, b, c, α , β , γ	145.65Å 145.65Å 64.21Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	72.55 – 1.58 72.55 – 1.58	Depositor EDS
% Data completeness (in resolution range)	99.5 (72.55-1.58) 99.6 (72.55-1.58)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.61 (at 1.58Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.209 , 0.220 0.208 , 0.219	Depositor DCC
R_{free} test set	3502 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	21.5	Xtriage
Anisotropy	0.576	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 37.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.014 for h,-h-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	3133	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.03% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: CL

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	0.40	2/2973 (0.1%)	0.97	9/4057 (0.2%)

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	A	0	1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	12[A]	VAL	CB-CG1	8.28	1.79	1.52
1	A	12[B]	VAL	CB-CG1	8.28	1.79	1.52

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	12[A]	VAL	CG1-CB-CG2	14.96	143.71	110.80
1	A	12[B]	VAL	CG1-CB-CG2	14.96	143.71	110.80
1	A	12[A]	VAL	CA-CB-CG1	-9.70	93.91	110.40
1	A	12[B]	VAL	CA-CB-CG1	-9.70	93.91	110.40
1	A	323	GLU	N-CA-C	-7.05	100.35	110.08
1	A	315	PRO	N-CA-C	6.68	116.88	110.47
1	A	236	ALA	N-CA-C	5.72	118.87	109.72
1	A	339	SER	N-CA-C	-5.72	102.02	110.48
1	A	197	PHE	N-CA-C	-5.46	100.80	109.76

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	310	TYR	Sidechain

5.2 Too-close contacts

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	2861	0	2771	67	0
2	A	1	0	0	0	0
3	A	271	0	0	6	0
All	All	3133	0	2771	67	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 12.

All (67) 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:191:ILE:HD11	1:A:215:ASP:H	1.25	1.01
1:A:12[A]:VAL:CG1	1:A:13:PHE:CD2	2.46	0.98
1:A:191:ILE:HD11	1:A:215:ASP:N	1.88	0.89
1:A:93:ALA:H	1:A:166:GLN:HE22	1.18	0.88
1:A:326:LEU:HD21	1:A:329:LYS:HG2	1.58	0.85
1:A:185:HIS:HD2	1:A:186:PRO:HD2	1.43	0.82
1:A:217:LEU:HD11	1:A:237:ARG:NE	1.98	0.79
1:A:12[A]:VAL:HG12	1:A:13:PHE:CD2	2.17	0.77
1:A:217:LEU:HD12	1:A:237:ARG:HD3	1.70	0.74
1:A:217:LEU:HG	1:A:237:ARG:HB3	1.70	0.74
1:A:217:LEU:CD1	1:A:237:ARG:CD	2.68	0.71
1:A:247:GLN:HE21	1:A:256:GLN:HE22	1.39	0.70
1:A:247:GLN:HE21	1:A:256:GLN:NE2	1.89	0.69
1:A:217:LEU:HD11	1:A:237:ARG:CD	2.22	0.69
1:A:12[A]:VAL:HG11	1:A:13:PHE:CE2	2.29	0.68
1:A:92:ASP:OD2	1:A:202:HIS:HD2	1.76	0.67
1:A:12[A]:VAL:CG1	1:A:13:PHE:CE2	2.81	0.62
1:A:217:LEU:CD1	1:A:237:ARG:HD3	2.28	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:217:LEU:CD1	1:A:237:ARG:NE	2.63	0.61
1:A:123:ARG:HG2	3:A:1203:HOH:O	2.00	0.61
1:A:185:HIS:CD2	1:A:186:PRO:HD2	2.33	0.60
1:A:123:ARG:HD3	1:A:141:ASP:OD2	2.02	0.59
1:A:12[B]:VAL:CG2	1:A:55:ARG:HD3	2.32	0.59
1:A:12[A]:VAL:CG1	1:A:12[A]:VAL:HB	2.17	0.58
1:A:12[A]:VAL:HG11	1:A:13:PHE:CD2	2.36	0.55
1:A:217:LEU:HD11	1:A:237:ARG:HG2	1.89	0.55
1:A:56:ARG:HG2	3:A:1094:HOH:O	2.06	0.54
1:A:217:LEU:HD23	1:A:217:LEU:N	2.23	0.54
1:A:78:ARG:HG3	3:A:1051:HOH:O	2.09	0.53
1:A:93:ALA:H	1:A:166:GLN:NE2	1.99	0.53
1:A:217:LEU:HD12	1:A:237:ARG:CD	2.36	0.52
1:A:237:ARG:HD2	1:A:272:CYS:C	2.35	0.52
1:A:191:ILE:C	1:A:191:ILE:HD13	2.36	0.51
1:A:217:LEU:HD11	1:A:237:ARG:CG	2.41	0.50
1:A:187:ILE:HG23	1:A:188:GLN:N	2.27	0.50
1:A:185:HIS:ND1	1:A:188:GLN:HG2	2.27	0.50
1:A:61:ALA:HB3	1:A:62:PRO:HD3	1.94	0.50
1:A:191:ILE:CD1	1:A:215:ASP:H	2.11	0.49
1:A:88[A]:CYS:SG	1:A:160:GLY:HA3	2.53	0.49
1:A:336:ASP:OD2	1:A:336:ASP:C	2.54	0.49
1:A:12[B]:VAL:HG22	1:A:55:ARG:HD3	1.94	0.49
1:A:90:LEU:HB2	1:A:164:CYS:HB2	1.95	0.48
1:A:161:PRO:HD2	1:A:218:GLU:HB3	1.95	0.48
1:A:217:LEU:CD1	1:A:237:ARG:CZ	2.92	0.48
1:A:245:GLN:HG2	3:A:1110:HOH:O	2.13	0.47
1:A:12[A]:VAL:HG12	1:A:13:PHE:N	2.30	0.47
1:A:55:ARG:HG2	1:A:71:GLN:HA	1.99	0.45
1:A:191:ILE:HD13	1:A:192:PRO:O	2.17	0.45
1:A:217:LEU:HG	1:A:237:ARG:CB	2.44	0.45
1:A:180:ALA:O	1:A:192:PRO:HA	2.17	0.44
1:A:88[B]:CYS:HB3	1:A:101:PHE:HB2	1.98	0.44
1:A:92:ASP:OD2	1:A:202:HIS:CD2	2.65	0.44
1:A:237:ARG:HA	1:A:266:GLU:OE2	2.17	0.44
1:A:25:LEU:HB3	1:A:336:ASP:OD2	2.18	0.44
1:A:93:ALA:N	1:A:166:GLN:HE22	1.99	0.43
1:A:262:LYS:HG2	3:A:1199:HOH:O	2.19	0.43
1:A:262:LYS:HE3	3:A:1185:HOH:O	2.18	0.43
1:A:24:ALA:HB3	1:A:37:PHE:HB2	2.00	0.43
1:A:88[A]:CYS:SG	1:A:159:VAL:HG23	2.59	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:225:GLU:HG2	1:A:230:ARG:HG2	2.02	0.42
1:A:51:LEU:HD12	1:A:51:LEU:C	2.45	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	362/382 (95%)	345 (95%)	16 (4%)	1 (0%)	36 20

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	212	VAL

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	310/318 (98%)	303 (98%)	7 (2%)	44 14

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	12[A]	VAL

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Mol	Chain	Res	Type
1	A	12[B]	VAL
1	A	191	ILE
1	A	217	LEU
1	A	218	GLU
1	A	229	GLN
1	A	336	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	71	GLN
1	A	166	GLN
1	A	168	ASN
1	A	185	HIS
1	A	202	HIS
1	A	210	HIS
1	A	239	HIS
1	A	256	GLN
1	A	259	GLN

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 1 ligands modelled in this entry, 1 is 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

There are no such residues in this entry.

5.8 Polymer linkage issues

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	362/382 (94%)	1.18	85 (23%) 2 3	16, 25, 39, 57	6 (1%)

All (85) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	217	LEU	10.9
1	A	227	GLY	6.8
1	A	187	ILE	6.1
1	A	115	LEU	6.0
1	A	185	HIS	5.0
1	A	4	LEU	4.6
1	A	228	GLU	4.3
1	A	230	ARG	4.0
1	A	186	PRO	4.0
1	A	41	ARG	3.8
1	A	189	ARG	3.8
1	A	225	GLU	3.8
1	A	51	LEU	3.7
1	A	50	GLU	3.7
1	A	95	THR	3.7
1	A	78	ARG	3.7
1	A	117	THR	3.6
1	A	16	GLY	3.6
1	A	116	GLN	3.6
1	A	191	ILE	3.6
1	A	288	SER	3.5
1	A	17	ALA	3.5
1	A	229	GLN	3.5
1	A	332[A]	CYS	3.5
1	A	377	TYR	3.4
1	A	114	GLN	3.4
1	A	260	LEU	3.4

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Mol	Chain	Res	Type	RSRZ
1	A	111	GLN	3.3
1	A	336	ASP	3.2
1	A	282	PRO	3.2
1	A	188	GLN	3.0
1	A	226	THR	3.0
1	A	109	VAL	2.9
1	A	374	PRO	2.9
1	A	164	CYS	2.9
1	A	214	GLN	2.9
1	A	119	ALA	2.9
1	A	12[A]	VAL	2.9
1	A	11	SER	2.9
1	A	215	ASP	2.8
1	A	375	ALA	2.8
1	A	241	ARG	2.8
1	A	80	ASP	2.7
1	A	56	ARG	2.7
1	A	18	HIS	2.7
1	A	289	PRO	2.7
1	A	152	ARG	2.7
1	A	329	LYS	2.6
1	A	107	GLY	2.6
1	A	210	HIS	2.6
1	A	245	GLN	2.6
1	A	259	GLN	2.6
1	A	94	GLN	2.6
1	A	325[A]	VAL	2.5
1	A	19	ALA	2.4
1	A	14	GLN	2.4
1	A	64	HIS	2.4
1	A	357	ASN	2.4
1	A	134	ARG	2.4
1	A	108	GLN	2.4
1	A	83	ARG	2.4
1	A	262	LYS	2.4
1	A	283	ARG	2.3
1	A	112	GLU	2.3
1	A	326	LEU	2.3
1	A	376	GLU	2.3
1	A	63	THR	2.2
1	A	138	SER	2.2
1	A	142	LEU	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	184	LEU	2.2
1	A	270	GLN	2.2
1	A	73	VAL	2.2
1	A	365	LEU	2.1
1	A	110	THR	2.1
1	A	65	GLN	2.1
1	A	6	VAL	2.1
1	A	81	GLY	2.1
1	A	75	ALA	2.1
1	A	149	PRO	2.1
1	A	319	GLU	2.1
1	A	72	GLU	2.1
1	A	144	ASP	2.1
1	A	218	GLU	2.0
1	A	360	GLU	2.0
1	A	88[A]	CYS	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
2	CL	A	1001	1/1	0.99	0.05	26,26,26,26	0

6.5 Other polymers [i](#)

There are no such residues in this entry.