



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 07:34 PM UTC

PDB ID : 5FIS / pdb_00005fis
Title : Exonuclease domain-containing 1 (Exd1) in the Gd bound conformation
Authors : Yang, Z.; Chen, K.M.; Pandey, R.R.; Homolka, D.; Reuter, M.; Rodino Janeiro, B.K.; Sachidanandam, R.; Fauvarque, M.O.; McCarthy, A.A.; Pillai, R.S.
Deposited on : 2015-10-02
Resolution : 1.60 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)
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

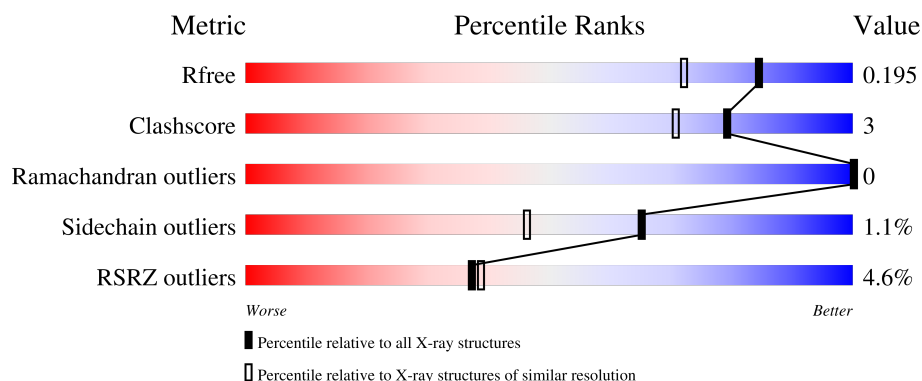
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.60 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	4673 (1.60-1.60)
Clashscore	190562	4931 (1.60-1.60)
Ramachandran outliers	187476	4831 (1.60-1.60)
Sidechain outliers	187428	4830 (1.60-1.60)
RSRZ outliers	180081	4672 (1.60-1.60)

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	243	4% 84% 14% ..
2	B	243	5% 81% 17% .

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 4342 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 EXD1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	241	Total	C	N	O	S	0	3	0
			1976	1263	334	369	10			

- Molecule 2 is a protein called EXD1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	241	Total	C	N	O	S	0	0	0
			1952	1242	334	366	10			

- Molecule 3 is GADOLINIUM ATOM (CCD ID: GD) (formula: Gd).

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

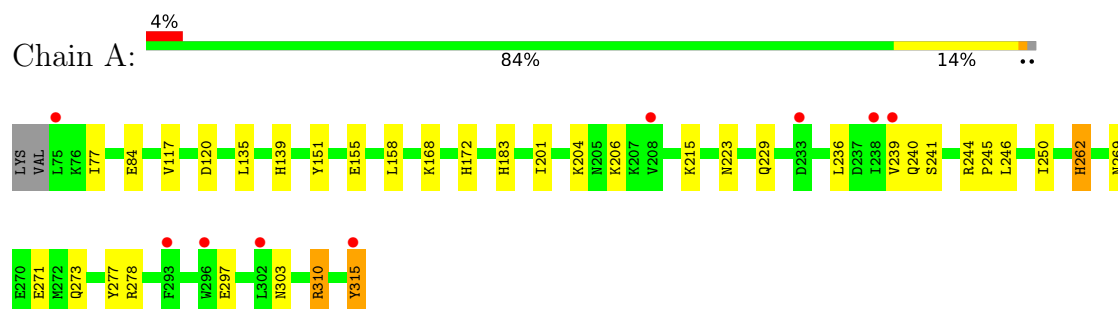
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	233	Total	O	0	0
			233	233		
4	B	178	Total	O	0	0
			178	178		

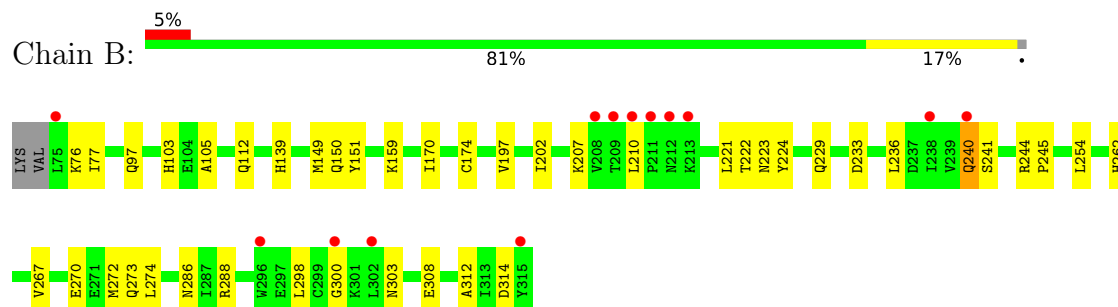
3 Residue-property plots [i](#)

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: EXD1



• Molecule 2: EXD1



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	82.86Å 135.70Å 51.46Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.01 – 1.60 50.01 – 1.60	Depositor EDS
% Data completeness (in resolution range)	99.2 (50.01-1.60) 99.2 (50.01-1.60)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.95 (at 1.60Å)	Xtriage
Refinement program	REFMAC 5.8.0131	Depositor
R, R_{free}	0.157 , 0.182 0.172 , 0.195	Depositor DCC
R_{free} test set	3895 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å ²)	19.3	Xtriage
Anisotropy	0.108	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 28.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	4342	wwPDB-VP
Average B, all atoms (Å ²)	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.91% 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: CSO, GD

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	1.71	18/2013 (0.9%)	1.43	12/2705 (0.4%)
2	B	1.68	29/1978 (1.5%)	1.36	3/2658 (0.1%)
All	All	1.70	47/3991 (1.2%)	1.40	15/5363 (0.3%)

All (47) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	271	GLU	CD-OE2	7.93	1.40	1.25
1	A	310	ARG	CA-C	-7.70	1.42	1.52
2	B	207	LYS	N-CA	6.66	1.54	1.46
1	A	240	GLN	CA-C	6.39	1.61	1.52
2	B	150	GLN	C-O	6.33	1.30	1.24
2	B	202	ILE	N-CA	6.22	1.53	1.46
2	B	314	ASP	CG-OD1	6.09	1.36	1.25
2	B	312	ALA	CA-C	-6.07	1.45	1.52
2	B	197	VAL	CA-CB	-6.06	1.47	1.54
1	A	246	LEU	N-CA	-6.06	1.38	1.46
2	B	224	TYR	N-CA	-6.02	1.38	1.46
1	A	236	LEU	C-O	-6.00	1.16	1.23
2	B	97	GLN	CA-C	-5.95	1.45	1.52
1	A	262	HIS	CA-CB	5.90	1.62	1.53
2	B	221	LEU	CA-C	5.81	1.60	1.52
1	A	250	ILE	CA-CB	-5.78	1.47	1.54
2	B	76	LYS	C-O	-5.77	1.16	1.24
1	A	239	VAL	CA-CB	5.76	1.61	1.54
2	B	151	TYR	N-CA	-5.74	1.38	1.46
2	B	222	THR	N-CA	5.74	1.53	1.46
2	B	170	ILE	CA-C	-5.68	1.45	1.52
2	B	314	ASP	C-O	-5.68	1.16	1.23
1	A	84	GLU	CA-C	5.67	1.60	1.52
2	B	308	GLU	CD-OE1	5.64	1.36	1.25

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	135	LEU	CA-C	-5.60	1.45	1.52
1	A	269	ASN	CA-C	5.59	1.60	1.52
1	A	223	ASN	CA-C	-5.45	1.45	1.52
2	B	202	ILE	CA-CB	-5.44	1.47	1.54
2	B	149	MET	C-O	5.42	1.31	1.24
1	A	172	HIS	CA-C	-5.38	1.46	1.52
2	B	236	LEU	CA-C	5.35	1.59	1.52
2	B	274	LEU	N-CA	5.30	1.51	1.46
2	B	159	LYS	CA-C	-5.29	1.46	1.52
1	A	278	ARG	C-O	5.28	1.30	1.24
1	A	117	VAL	CA-C	-5.27	1.46	1.52
2	B	272	MET	SD-CE	-5.26	1.66	1.79
1	A	77	ILE	C-O	5.20	1.30	1.23
1	A	151	TYR	N-CA	-5.20	1.39	1.46
2	B	174	CYS	C-O	5.20	1.31	1.24
2	B	241	SER	N-CA	5.17	1.53	1.46
2	B	298	LEU	C-O	5.17	1.30	1.24
2	B	105	ALA	CA-C	-5.16	1.46	1.52
2	B	267	VAL	CA-CB	-5.14	1.48	1.54
1	A	241	SER	C-O	5.08	1.30	1.24
2	B	254	LEU	CA-C	-5.07	1.46	1.52
2	B	233	ASP	CA-C	-5.07	1.46	1.52
2	B	300	GLY	N-CA	5.06	1.51	1.45

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	229	GLN	N-CA-C	6.74	120.61	112.38
1	A	229	GLN	N-CA-C	6.31	120.08	112.38
1	A	297	GLU	CB-CG-CD	-5.79	102.77	112.60
2	B	223	ASN	N-CA-C	5.75	117.54	111.28
1	A	201	ILE	O-C-N	5.74	127.54	121.91
1	A	120	ASP	CA-C-O	5.67	127.39	120.92
1	A	84	GLU	N-CA-C	-5.67	105.01	111.07
1	A	277	TYR	CE1-CZ-OH	-5.65	102.95	119.90
2	B	314	ASP	CA-CB-CG	5.62	118.22	112.60
1	A	223	ASN	N-CA-C	5.53	117.39	111.36
1	A	262	HIS	O-C-N	-5.37	116.43	122.12
1	A	229	GLN	CA-C-N	-5.36	114.58	122.83
1	A	229	GLN	C-N-CA	-5.36	114.58	122.83
1	A	158	LEU	N-CA-CB	5.24	117.91	110.16
1	A	155	GLU	CA-CB-CG	5.04	124.18	114.10

There are no chirality outliers.

There are no planarity outliers.

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	1976	0	2004	13	0
2	B	1952	0	1974	13	0
3	A	2	0	0	0	0
3	B	1	0	0	0	0
4	A	233	0	0	7	0
4	B	178	0	0	3	0
All	All	4342	0	3978	21	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 3.

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)
1:A:204:LYS:NZ	4:A:2151:HOH:O	2.26	0.68
1:A:139:HIS:HD2	4:A:2060:HOH:O	1.82	0.62
1:A:310:ARG:HG2	2:B:210:LEU:HD12	1.83	0.60
2:B:139:HIS:HD2	4:B:2046:HOH:O	1.86	0.58
4:A:2057:HOH:O	2:B:139:HIS:HE1	1.86	0.57
2:B:240:GLN:HE21	2:B:240:GLN:HA	1.68	0.57
1:A:215:LYS:HE3	4:A:2148:HOH:O	2.05	0.56
1:A:315:TYR:C	1:A:315:TYR:CD1	2.86	0.53
1:A:244:ARG:HA	1:A:245:PRO:C	2.35	0.52
2:B:103:HIS:HD2	4:B:2087:HOH:O	1.93	0.51
1:A:139:HIS:HE1	4:A:2010:HOH:O	1.93	0.49
2:B:244:ARG:HA	2:B:245:PRO:C	2.38	0.48
4:A:2136:HOH:O	2:B:286:ASN:ND2	2.45	0.47
2:B:112:GLN:NE2	4:B:2043:HOH:O	2.46	0.46
1:A:262:HIS:HD2	4:A:2093:HOH:O	1.98	0.45
1:A:273[A]:GLN:NE2	2:B:273:GLN:NE2	2.67	0.43
1:A:183:HIS:HE1	2:B:288:ARG:O	2.01	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:310:ARG:HG2	2:B:210:LEU:CD1	2.49	0.42
1:A:206:LYS:HE3	1:A:206:LYS:HB3	1.77	0.42
1:A:168:LYS:NZ	2:B:270:GLU:OE2	2.46	0.41
2:B:77:ILE:HG21	2:B:77:ILE:HD13	1.80	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	241/243 (99%)	230 (95%)	11 (5%)	0	100	100
2	B	238/243 (98%)	228 (96%)	10 (4%)	0	100	100
All	All	479/486 (99%)	458 (96%)	21 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	224/223 (100%)	222 (99%)	2 (1%)	70	55
2	B	220/223 (99%)	217 (99%)	3 (1%)	59	38
All	All	444/446 (100%)	439 (99%)	5 (1%)	65	46

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

Mol	Chain	Res	Type
1	A	303	ASN
1	A	315	TYR
2	B	240	GLN
2	B	262	HIS
2	B	303	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (15) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	79	GLN
1	A	112	GLN
1	A	123	ASN
1	A	139	HIS
1	A	147	GLN
1	A	183	HIS
1	A	262	HIS
2	B	79	GLN
2	B	103	HIS
2	B	112	GLN
2	B	139	HIS
2	B	147	GLN
2	B	152	HIS
2	B	240	GLN
2	B	273	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

2 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
1	CSO	A	128	1	3,6,7	1.01	0	1,6,8	1.67	0
2	CSO	B	128	2	3,6,7	1.08	0	1,6,8	1.72	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
1	CSO	A	128	1	-	0/1/5/7	-
2	CSO	B	128	2	-	0/1/5/7	-

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.

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 3 ligands modelled in this entry, 3 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, 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	240/243 (98%)	-0.02	9 (3%)	44 46	12, 20, 44, 90	3 (1%)
2	B	240/243 (98%)	0.01	13 (5%)	31 32	14, 22, 47, 78	0
All	All	480/486 (98%)	-0.00	22 (4%)	37 39	12, 21, 45, 90	3 (0%)

All (22) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	315	TYR	5.4
2	B	208	VAL	4.8
1	A	302	LEU	4.2
2	B	315	TYR	4.0
1	A	296	TRP	3.7
1	A	75	LEU	3.6
2	B	75	LEU	3.5
1	A	293[A]	PHE	3.2
1	A	239	VAL	3.0
2	B	296	TRP	2.9
2	B	211	PRO	2.9
2	B	238	ILE	2.9
2	B	302	LEU	2.8
2	B	210	LEU	2.6
2	B	300	GLY	2.5
2	B	240	GLN	2.4
2	B	209	THR	2.4
1	A	208	VAL	2.3
2	B	213	LYS	2.3
1	A	233	ASP	2.2
2	B	212	ASN	2.1
1	A	238	ILE	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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($\text{\AA}^2$)	Q<0.9
2	CSO	B	128	7/8	0.93	0.09	20,21,39,40	0
1	CSO	A	128	7/8	0.94	0.07	19,19,37,38	0

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($\text{\AA}^2$)	Q<0.9
3	GD	A	1317	1/1	0.81	0.11	20,20,20,20	1
3	GD	A	1316	1/1	1.00	0.01	17,17,17,17	0
3	GD	B	1316	1/1	1.00	0.01	17,17,17,17	0

6.5 Other polymers [i](#)

There are no such residues in this entry.