



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:10 AM UTC

PDB ID : 2FUS / pdb_00002fus
Title : MUTATIONS OF FUMARASE THAT DISTINGUISH BETWEEN THE ACTIVE SITE AND A NEARBY DICARBOXYLIC ACID BINDING SITE
Authors : Weaver, T.M.; Lees, M.; Banaszak, L.J.
Deposited on : 1997-01-09
Resolution : 2.20 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

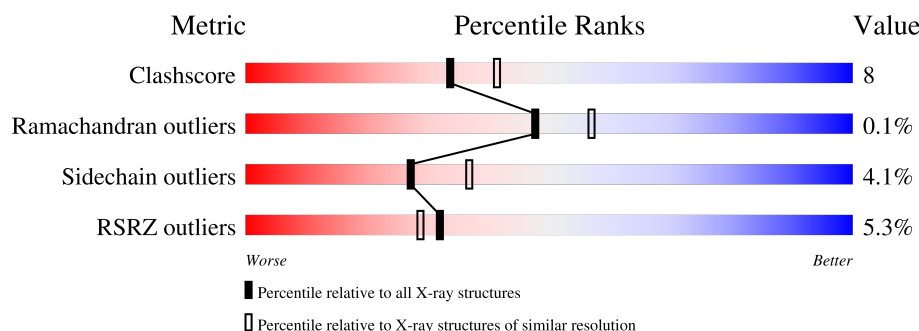
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.20 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	190562	6851 (2.20-2.20)
Ramachandran outliers	187476	6768 (2.20-2.20)
Sidechain outliers	187428	6769 (2.20-2.20)
RSRZ outliers	180081	6166 (2.20-2.20)

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	467	 9% 79% 16% . .
1	B	467	 % 80% 16% . .

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	CIT	A	468	-	X	-	-
2	CIT	B	468	-	X	-	-

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 9610 atoms, of which 2306 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.

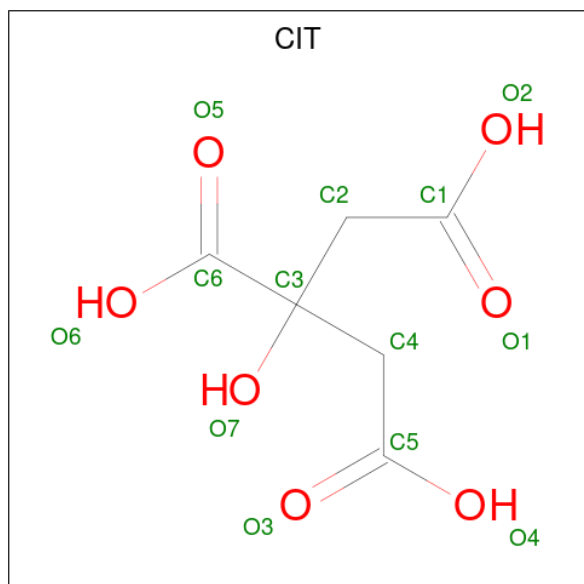
- Molecule 1 is a protein called FUMARASE C.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	456	Total	C	H	N	O	S	0	0	0
			4235	2156	781	616	659	23			
1	B	455	Total	C	H	N	O	S	0	0	0
			4236	2155	783	616	658	24			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	129	ASN	HIS	engineered mutation	UNP P05042
B	129	ASN	HIS	engineered mutation	UNP P05042

- Molecule 2 is CITRIC ACID (CCD ID: CIT) (formula: C₆H₈O₇).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			13	6	7		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	B	1	Total	C	O	0	0
			13	6	7		

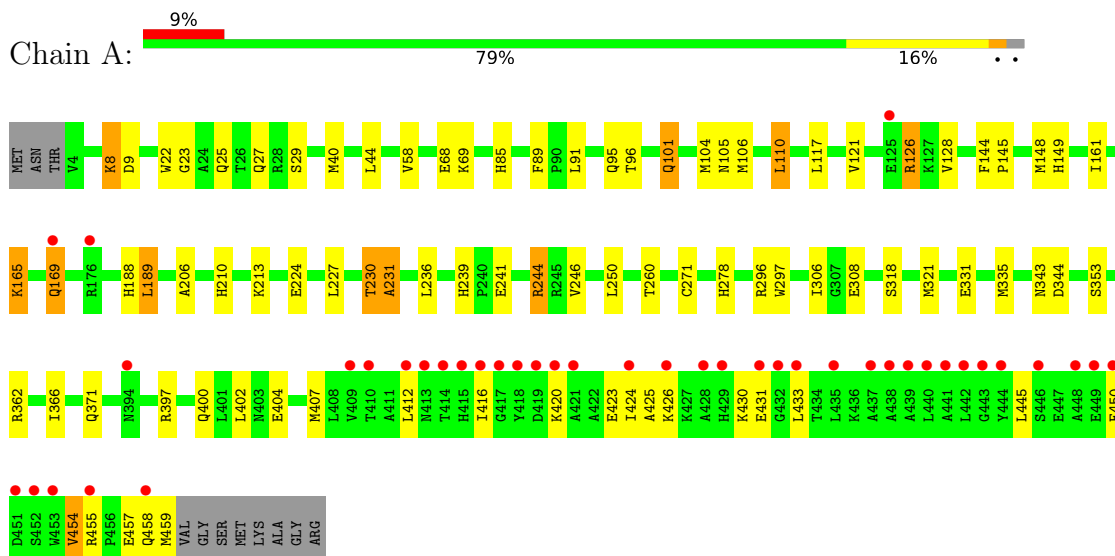
- Molecule 3 is water.

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	198	Total	H	O	0	0
			594	396	198		
3	B	173	Total	H	O	0	0
			519	346	173		

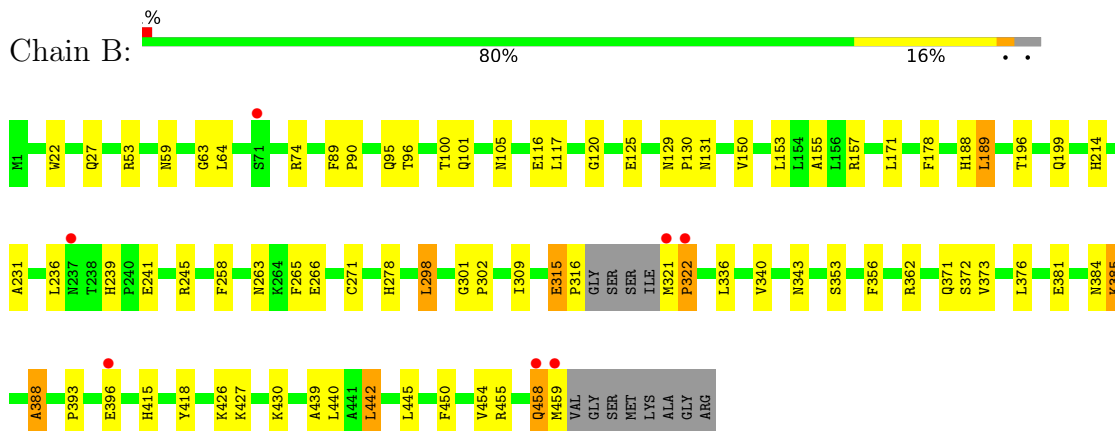
3 Residue-property plots [i](#)

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: FUMARASE C



• Molecule 1: FUMARASE C



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	104.16Å 220.05Å 86.65Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	8.00 – 2.20 8.00 – 2.20	Depositor EDS
% Data completeness (in resolution range)	87.8 (8.00-2.20) 84.9 (8.00-2.20)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.12	Depositor
$\langle I/\sigma(I) \rangle$ ¹	0.65 (at 1.99Å)	Xtriage
Refinement program	X-PLOR 3.1	Depositor
R, R_{free}	0.178 , 0.229 0.217 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å ²)	20.0	Xtriage
Anisotropy	0.489	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 64.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	9610	wwPDB-VP
Average B, all atoms (Å ²)	18.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.33% 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: CIT

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	0.48	0/3511	0.94	6/4756 (0.1%)
1	B	0.48	0/3509	0.95	6/4752 (0.1%)
All	All	0.48	0/7020	0.94	12/9508 (0.1%)

There are no bond length outliers.

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	231	ALA	N-CA-C	8.34	121.12	111.11
1	B	362	ARG	N-CA-C	7.36	122.75	112.75
1	B	231	ALA	N-CA-C	7.21	118.83	110.97
1	A	362	ARG	N-CA-C	7.13	122.44	112.75
1	A	353	SER	N-CA-C	6.59	120.23	112.72
1	B	353	SER	N-CA-C	6.26	119.86	112.72
1	A	271	CYS	N-CA-C	-6.21	102.98	111.56
1	B	271	CYS	N-CA-C	-5.87	104.78	112.41
1	B	388	ALA	N-CA-C	5.59	117.82	111.11
1	A	23	GLY	N-CA-C	5.12	118.93	112.79
1	A	454	VAL	N-CA-C	5.10	111.67	106.21
1	B	356	PHE	CB-CA-C	-5.07	110.33	117.23

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	3454	781	3472	62	2
1	B	3453	783	3472	47	2
2	A	13	0	3	0	0
2	B	13	0	3	0	0
3	A	198	396	0	6	3
3	B	173	346	0	4	1
All	All	7304	2306	6950	107	4

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 (107) 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:230:THR:HG23	1:A:231:ALA:H	1.38	0.86
1:A:431:GLU:HB3	1:A:433:LEU:HD13	1.56	0.84
1:B:343:ASN:HD21	1:B:371:GLN:HE21	1.34	0.74
1:B:263:ASN:HD22	1:B:266:GLU:H	1.36	0.74
1:B:439:ALA:HB1	1:B:445:LEU:HD21	1.70	0.73
1:A:343:ASN:HD21	1:A:371:GLN:HE21	1.37	0.72
1:A:423:GLU:HA	1:A:426:LYS:HD2	1.76	0.66
1:B:450:PHE:CE1	1:B:454:VAL:HG11	2.31	0.64
1:A:85:HIS:HD2	3:A:536:HOH:O	1.79	0.64
1:A:230:THR:HG23	1:A:231:ALA:N	2.12	0.64
1:A:445:LEU:HD13	1:A:450:PHE:HB2	1.80	0.63
1:A:455:ARG:HH11	1:A:458:GLN:HE22	1.46	0.63
1:A:188:HIS:O	1:A:189:LEU:HB2	1.97	0.63
1:A:407:MET:SD	1:B:321:MET:HG2	2.39	0.62
1:B:450:PHE:O	1:B:454:VAL:HG12	1.99	0.62
1:A:22:TRP:HE1	1:A:27:GLN:NE2	1.97	0.62
1:B:415:HIS:HE1	3:B:562:HOH:O	1.83	0.61
1:B:89:PHE:HA	1:B:105:ASN:HD21	1.66	0.61
1:B:415:HIS:HD2	3:B:563:HOH:O	1.83	0.60
1:A:210:HIS:O	1:A:213:LYS:HG2	2.01	0.60
1:B:426:LYS:O	1:B:430:LYS:HD3	2.01	0.60
1:B:22:TRP:HE1	1:B:27:GLN:NE2	2.00	0.60
1:A:149:HIS:HD2	1:A:224:GLU:O	1.85	0.59
1:A:96:THR:HG23	1:A:101:GLN:HE22	1.68	0.59
1:A:230:THR:HG22	3:A:486:HOH:O	2.02	0.59

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:188:HIS:O	1:B:189:LEU:HB2	2.01	0.58
1:A:40:MET:SD	1:A:44:LEU:HD23	2.43	0.58
1:B:241:GLU:O	1:B:245:ARG:HG3	2.04	0.57
1:B:427:LYS:HE2	1:B:442:LEU:HD13	1.85	0.57
1:A:8:LYS:HB2	1:A:8:LYS:NZ	2.20	0.57
1:B:196:THR:H	1:B:199:GLN:NE2	2.02	0.57
1:A:230:THR:CG2	1:A:231:ALA:H	2.14	0.56
1:A:22:TRP:HE1	1:A:27:GLN:HE21	1.53	0.56
1:A:230:THR:CG2	1:A:231:ALA:N	2.70	0.55
1:A:89:PHE:HA	1:A:105:ASN:HD21	1.72	0.54
1:A:148:MET:HE3	1:A:366:ILE:HB	1.90	0.54
1:B:381:GLU:HG2	1:B:385:LYS:HE2	1.91	0.53
1:B:298:LEU:HB3	1:B:309:ILE:HG12	1.91	0.53
1:B:59:ASN:HD22	1:B:64:LEU:HD12	1.74	0.52
1:A:244:ARG:NH1	1:A:260:THR:H	2.08	0.52
1:A:25:GLN:NE2	1:A:104:MET:HE2	2.25	0.51
1:A:161:ILE:HG22	1:A:165:LYS:HE2	1.93	0.51
1:B:427:LYS:HE2	1:B:442:LEU:CD1	2.41	0.51
1:B:95:GLN:HB2	1:B:101:GLN:NE2	2.26	0.50
1:B:439:ALA:HB1	1:B:445:LEU:CD2	2.40	0.50
1:A:455:ARG:NH1	1:A:458:GLN:HE22	2.08	0.50
1:A:68:GLU:HG3	1:A:69:LYS:N	2.27	0.50
1:A:400:GLN:O	1:A:404:GLU:HB2	2.13	0.49
1:B:263:ASN:HD21	1:B:265:PHE:HB2	1.77	0.49
1:B:96:THR:HG21	1:B:100:THR:HB	1.94	0.49
1:A:239:HIS:CD2	1:A:241:GLU:H	2.31	0.49
1:A:8:LYS:HB2	1:A:8:LYS:HZ2	1.78	0.49
1:A:306:ILE:HG22	1:A:308:GLU:HG3	1.95	0.48
1:A:412:LEU:HD13	1:A:424:ILE:HD11	1.94	0.48
1:B:455:ARG:O	1:B:458:GLN:HG3	2.14	0.47
1:A:412:LEU:O	1:A:416:ILE:HG22	2.14	0.47
1:A:227:LEU:HD13	1:A:246:VAL:HG21	1.96	0.47
1:A:278:HIS:HD2	1:A:344:ASP:OD1	1.97	0.47
1:B:239:HIS:HD2	1:B:241:GLU:H	1.62	0.47
1:A:206:ALA:O	1:A:210:HIS:HD2	1.97	0.46
1:A:230:THR:HG21	1:A:236:LEU:O	2.16	0.46
1:A:91:LEU:HD13	1:A:101:GLN:HB3	1.98	0.46
1:B:125:GLU:HG2	3:B:582:HOH:O	2.15	0.46
1:B:384:ASN:HA	1:B:388:ALA:HB3	1.97	0.46
1:B:178:PHE:CZ	1:B:393:PRO:HD3	2.51	0.45
1:B:129:ASN:HA	1:B:130:PRO:HD3	1.89	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:153:LEU:HG	1:B:157:ARG:HD3	1.97	0.45
1:A:454:VAL:HG13	1:A:454:VAL:O	2.16	0.45
1:A:318:SER:HB2	1:A:321:MET:HB2	1.99	0.45
1:B:315:GLU:HB2	1:B:316:PRO:HD2	1.99	0.44
1:A:96:THR:HG23	1:A:101:GLN:NE2	2.31	0.44
1:B:155:ALA:HB1	1:B:373:VAL:HG11	1.99	0.44
1:A:149:HIS:CD2	1:A:224:GLU:O	2.69	0.44
1:A:144:PHE:HB3	1:A:145:PRO:HD3	1.99	0.44
1:A:244:ARG:HA	1:A:244:ARG:HD3	1.79	0.44
1:A:445:LEU:CD1	1:A:450:PHE:HB2	2.46	0.44
1:B:278:HIS:HE1	1:B:372:SER:OG	2.01	0.44
1:A:9:ASP:HB2	3:A:614:HOH:O	2.19	0.43
1:B:301:GLY:HA3	1:B:302:PRO:HA	1.90	0.43
1:B:442:LEU:HD12	1:B:442:LEU:HA	1.84	0.43
1:A:121:VAL:HG12	3:A:587:HOH:O	2.18	0.43
1:B:454:VAL:O	1:B:454:VAL:HG13	2.19	0.43
1:B:150:VAL:HA	1:B:258:PHE:CZ	2.54	0.43
1:A:425:ALA:HB1	1:B:322:PRO:HG2	1.99	0.43
1:B:53:ARG:HG3	1:B:74:ARG:HG3	2.00	0.43
1:B:116:GLU:HA	1:B:120:GLY:O	2.19	0.43
1:A:169:GLN:NE2	3:A:573:HOH:O	2.51	0.43
1:A:455:ARG:HB3	1:A:457:GLU:OE2	2.18	0.42
1:A:210:HIS:HA	1:A:213:LYS:HE3	2.01	0.42
1:A:29:SER:OG	1:A:101:GLN:HG3	2.19	0.42
1:A:126:ARG:HG3	1:A:128:VAL:O	2.20	0.42
1:A:58:VAL:HG21	1:A:246:VAL:HA	2.02	0.42
1:A:420:LYS:HD3	1:A:420:LYS:HA	1.88	0.41
1:A:450:PHE:O	1:A:454:VAL:HG12	2.20	0.41
1:A:343:ASN:HD21	1:A:371:GLN:NE2	2.11	0.41
1:A:95:GLN:OE1	1:A:101:GLN:HB2	2.19	0.41
1:A:96:THR:HG21	3:A:622:HOH:O	2.20	0.41
1:B:196:THR:H	1:B:199:GLN:HE21	1.68	0.41
1:B:263:ASN:ND2	1:B:266:GLU:H	2.11	0.41
1:B:63:GLY:HA2	3:B:574:HOH:O	2.20	0.41
1:B:22:TRP:HE1	1:B:27:GLN:HE21	1.67	0.41
1:B:239:HIS:CD2	1:B:241:GLU:H	2.39	0.41
1:B:336:LEU:O	1:B:340:VAL:HG23	2.21	0.41
1:A:106:MET:O	1:A:110:LEU:HB2	2.21	0.40
1:B:418:TYR:CD1	1:B:418:TYR:C	2.99	0.40
1:A:331:GLU:O	1:A:335:MET:HG3	2.21	0.40
1:A:206:ALA:O	1:A:210:HIS:CD2	2.74	0.40

All (4) 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:A:296:ARG:HH12	3:A:491:HOH:H2[3_756]	1.21	0.39
1:A:297:TRP:HE1	3:B:538:HOH:O[3_756]	1.42	0.18
1:B:214:HIS:HD1	3:A:510:HOH:O[3_756]	1.47	0.13
1:B:188:HIS:HE2	3:A:505:HOH:O[3_756]	1.60	0.00

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	454/467 (97%)	439 (97%)	15 (3%)	0	100	100
1	B	451/467 (97%)	432 (96%)	18 (4%)	1 (0%)	43	51
All	All	905/934 (97%)	871 (96%)	33 (4%)	1 (0%)	48	57

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	322	PRO

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	368/376 (98%)	353 (96%)	15 (4%)	27	37
1	B	368/376 (98%)	353 (96%)	15 (4%)	27	37

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	736/752 (98%)	706 (96%)	30 (4%)	27	37

All (30) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	8	LYS
1	A	101	GLN
1	A	110	LEU
1	A	117	LEU
1	A	126	ARG
1	A	165	LYS
1	A	169	GLN
1	A	189	LEU
1	A	230	THR
1	A	244	ARG
1	A	250	LEU
1	A	397	ARG
1	A	402	LEU
1	A	430	LYS
1	A	459	MET
1	B	90	PRO
1	B	117	LEU
1	B	131	ASN
1	B	171	LEU
1	B	189	LEU
1	B	236	LEU
1	B	298	LEU
1	B	315	GLU
1	B	376	LEU
1	B	385	LYS
1	B	396	GLU
1	B	440	LEU
1	B	442	LEU
1	B	458	GLN
1	B	459	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (40) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	25	GLN
1	A	27	GLN

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Mol	Chain	Res	Type
1	A	85	HIS
1	A	101	GLN
1	A	105	ASN
1	A	149	HIS
1	A	163	GLN
1	A	169	GLN
1	A	172	ASN
1	A	210	HIS
1	A	239	HIS
1	A	278	HIS
1	A	329	GLN
1	A	343	ASN
1	A	368	ASN
1	A	413	ASN
1	A	458	GLN
1	B	25	GLN
1	B	27	GLN
1	B	46	HIS
1	B	59	ASN
1	B	84	GLN
1	B	101	GLN
1	B	105	ASN
1	B	131	ASN
1	B	149	HIS
1	B	163	GLN
1	B	190	GLN
1	B	199	GLN
1	B	214	HIS
1	B	237	ASN
1	B	239	HIS
1	B	263	ASN
1	B	278	HIS
1	B	314	ASN
1	B	339	GLN
1	B	371	GLN
1	B	415	HIS
1	B	429	HIS
1	B	458	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

2 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$
2	CIT	B	468	-	12,12,12	3.98	3 (25%)	17,17,17	5.79	9 (52%)
2	CIT	A	468	-	12,12,12	4.44	4 (33%)	17,17,17	5.80	9 (52%)

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	CIT	B	468	-	-	6/16/16/16	-
2	CIT	A	468	-	-	8/16/16/16	-

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	468	CIT	C4-C3	12.83	1.69	1.54
2	B	468	CIT	C4-C3	11.34	1.68	1.54
2	A	468	CIT	C2-C1	-7.19	1.29	1.50
2	B	468	CIT	C2-C1	-6.79	1.30	1.50
2	A	468	CIT	O7-C3	-2.91	1.37	1.43
2	B	468	CIT	O7-C3	-2.34	1.38	1.43

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	468	CIT	O6-C6	-2.01	1.23	1.30

All (18) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	468	CIT	C3-C2-C1	12.61	148.41	113.92
2	B	468	CIT	C3-C2-C1	12.53	148.18	113.92
2	A	468	CIT	C3-C4-C5	11.71	145.93	113.92
2	B	468	CIT	C2-C3-C6	-11.70	84.15	110.03
2	B	468	CIT	C3-C4-C5	11.65	145.78	113.92
2	A	468	CIT	C2-C3-C6	-11.58	84.41	110.03
2	A	468	CIT	O7-C3-C4	6.92	125.16	109.38
2	B	468	CIT	O7-C3-C4	6.82	124.93	109.38
2	A	468	CIT	O7-C3-C2	4.90	120.55	109.38
2	B	468	CIT	O7-C3-C2	4.77	120.25	109.38
2	B	468	CIT	O6-C6-C3	4.59	121.95	113.14
2	A	468	CIT	O6-C6-C3	4.52	121.82	113.14
2	B	468	CIT	O1-C1-C2	-4.28	110.82	122.95
2	A	468	CIT	O1-C1-C2	-4.21	111.04	122.95
2	A	468	CIT	C4-C3-C6	-3.30	102.75	110.03
2	B	468	CIT	C4-C3-C6	-3.08	103.22	110.03
2	B	468	CIT	O6-C6-O5	-2.39	116.21	123.86
2	A	468	CIT	O6-C6-O5	-2.20	116.81	123.86

There are no chirality outliers.

All (14) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	468	CIT	C1-C2-C3-O7
2	A	468	CIT	C1-C2-C3-C6
2	A	468	CIT	O7-C3-C4-C5
2	B	468	CIT	C1-C2-C3-O7
2	B	468	CIT	C1-C2-C3-C6
2	A	468	CIT	C2-C3-C4-C5
2	A	468	CIT	C6-C3-C4-C5
2	B	468	CIT	C1-C2-C3-C4
2	A	468	CIT	C4-C3-C6-O5
2	A	468	CIT	C1-C2-C3-C4
2	A	468	CIT	C4-C3-C6-O6
2	B	468	CIT	C4-C3-C6-O5
2	B	468	CIT	C4-C3-C6-O6
2	B	468	CIT	O7-C3-C4-C5

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	456/467 (97%)	0.48	41 (8%) 15 12	3, 14, 65, 86	0
1	B	455/467 (97%)	0.15	7 (1%) 72 69	3, 14, 32, 86	0
All	All	911/934 (97%)	0.32	48 (5%) 32 29	3, 14, 55, 86	0

All (48) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	322	PRO	4.6
1	B	459	MET	4.3
1	B	458	GLN	4.1
1	A	416	ILE	4.0
1	A	414	THR	4.0
1	A	415	HIS	3.9
1	A	417	GLY	3.9
1	A	451	ASP	3.9
1	A	452	SER	3.7
1	B	321	MET	3.5
1	A	413	ASN	3.2
1	A	412	LEU	3.1
1	A	437	ALA	3.0
1	A	424	ILE	3.0
1	A	125	GLU	2.9
1	A	431	GLU	2.9
1	A	432	GLY	2.8
1	A	169	GLN	2.8
1	A	439	ALA	2.8
1	A	441	ALA	2.8
1	A	448	ALA	2.7
1	A	450	PHE	2.7
1	A	420	LYS	2.6
1	A	429	HIS	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	71	SER	2.5
1	A	455	ARG	2.5
1	A	409	VAL	2.5
1	A	458	GLN	2.4
1	A	418	TYR	2.4
1	A	446	SER	2.4
1	A	419	ASP	2.4
1	A	453	TRP	2.4
1	A	410	THR	2.3
1	A	428	ALA	2.3
1	A	394	ASN	2.3
1	A	449	GLU	2.3
1	A	426	LYS	2.2
1	A	176	ARG	2.2
1	A	421	ALA	2.2
1	A	435	LEU	2.1
1	B	237	ASN	2.1
1	A	433	LEU	2.1
1	A	443	GLY	2.1
1	A	438	ALA	2.1
1	B	396	GLU	2.1
1	A	444	TYR	2.1
1	A	440	LEU	2.0
1	A	442	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($\text{\AA}^2$)	Q<0.9
2	CIT	A	468	13/13	0.70	0.17	57,63,64,66	0
2	CIT	B	468	13/13	0.78	0.15	53,55,64,65	0

6.5 Other polymers [i](#)

There are no such residues in this entry.