



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 13, 2024 – 03:25 PM JST

PDB ID : 4ZXA
Title : Crystal Structure of hydroquinone 1,2-dioxygenase PnpCD in complex with Cd²⁺ and 4-hydroxybenzoxitrile
Authors : Liu, S.; Su, T.; Zhang, C.; Gu, L.
Deposited on : 2015-05-20
Resolution : 2.49 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.36
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.36

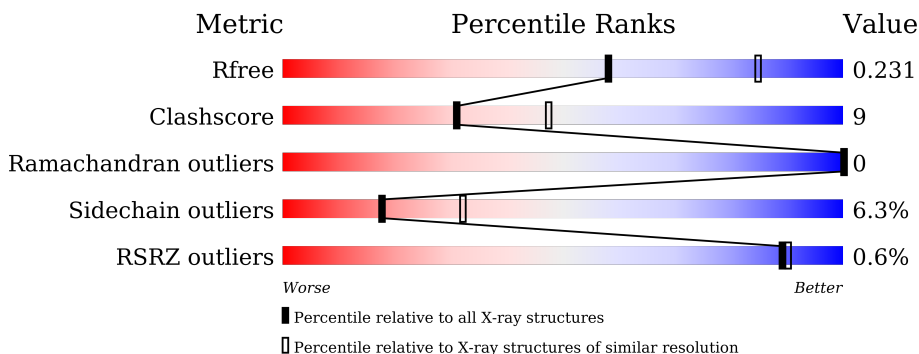
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.49 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}	130704	5857 (2.50-2.46)
Clashscore	141614	6594 (2.50-2.46)
Ramachandran outliers	138981	6469 (2.50-2.46)
Sidechain outliers	138945	6471 (2.50-2.46)
RSRZ outliers	127900	5738 (2.50-2.46)

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	168	79% 17% ..
1	B	168	73% 21% ..
1	C	168	74% 21% ..
1	D	168	78% 18% ..
2	W	339	80% 14% ..
2	X	339	73% 20% ..

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Mol	Chain	Length	Quality of chain
2	Y	339	 80% 14% . .
2	Z	339	 73% 21% . .

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 16274 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 Hydroquinone dioxygenase small subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	163	1269	812	219	234	4	0	1	0
1	B	163	1261	808	217	232	4	0	0	0
1	C	163	1272	814	221	233	4	0	1	0
1	D	163	1261	808	217	232	4	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	GLY	-	expression tag	UNP C1I210
A	-2	PRO	-	expression tag	UNP C1I210
A	-1	GLY	-	expression tag	UNP C1I210
A	0	SER	-	expression tag	UNP C1I210
B	-3	GLY	-	expression tag	UNP C1I210
B	-2	PRO	-	expression tag	UNP C1I210
B	-1	GLY	-	expression tag	UNP C1I210
B	0	SER	-	expression tag	UNP C1I210
C	-3	GLY	-	expression tag	UNP C1I210
C	-2	PRO	-	expression tag	UNP C1I210
C	-1	GLY	-	expression tag	UNP C1I210
C	0	SER	-	expression tag	UNP C1I210
D	-3	GLY	-	expression tag	UNP C1I210
D	-2	PRO	-	expression tag	UNP C1I210
D	-1	GLY	-	expression tag	UNP C1I210
D	0	SER	-	expression tag	UNP C1I210

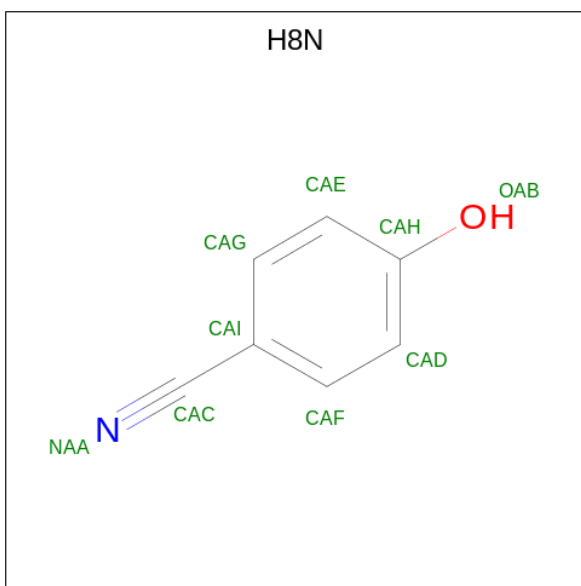
- Molecule 2 is a protein called Hydroquinone dioxygenase large subunit.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	W	324	Total	C	N	O	S	0	2	0
			2620	1668	448	491	13			
2	X	324	Total	C	N	O	S	0	1	0
			2611	1663	447	488	13			
2	Y	324	Total	C	N	O	S	0	1	0
			2611	1663	447	488	13			
2	Z	324	Total	C	N	O	S	0	1	0
			2610	1662	445	490	13			

- Molecule 3 is CADMIUM ION (three-letter code: CD) (formula: Cd).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	W	1	Total	Cd	0	0
			1	1		
3	X	1	Total	Cd	0	0
			1	1		
3	Y	1	Total	Cd	0	0
			1	1		
3	Z	1	Total	Cd	0	0
			1	1		

- Molecule 4 is 4-hydroxybenzonitrile (three-letter code: H8N) (formula: C₇H₅NO).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	W	1	Total	C	N	O	0	0
			9	7	1	1		
4	X	1	Total	C	N	O	0	0
			9	7	1	1		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	Y	1	Total	C	N	O	0	0
			9	7	1	1		
4	Z	1	Total	C	N	O	0	0
			9	7	1	1		

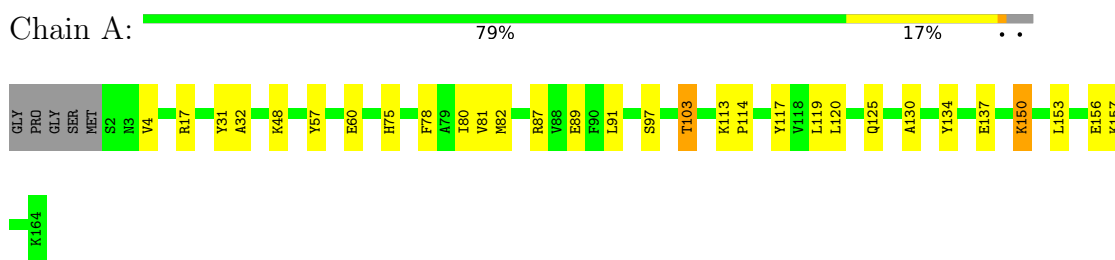
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	63	Total	O	0	0
			63	63		
5	B	38	Total	O	0	0
			38	38		
5	C	38	Total	O	0	0
			38	38		
5	D	65	Total	O	0	0
			65	65		
5	W	156	Total	O	0	0
			156	156		
5	X	123	Total	O	0	0
			123	123		
5	Y	117	Total	O	0	0
			117	117		
5	Z	119	Total	O	0	0
			119	119		

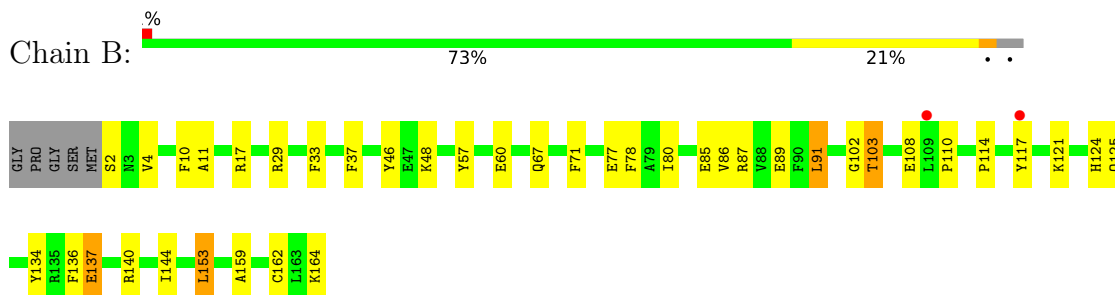
3 Residue-property plots

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.

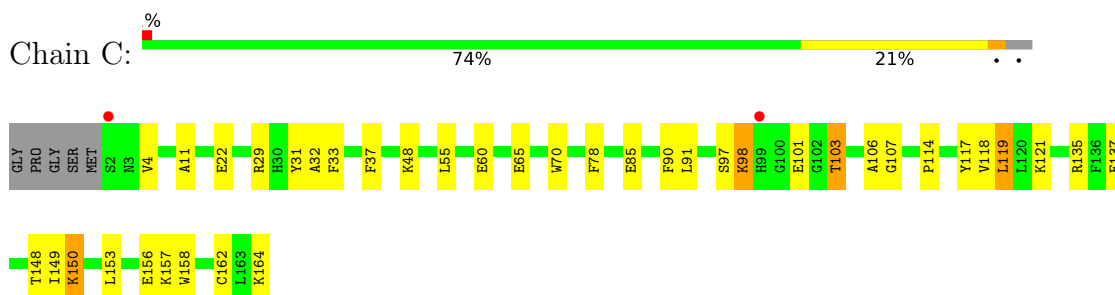
- Molecule 1: Hydroquinone dioxygenase small subunit



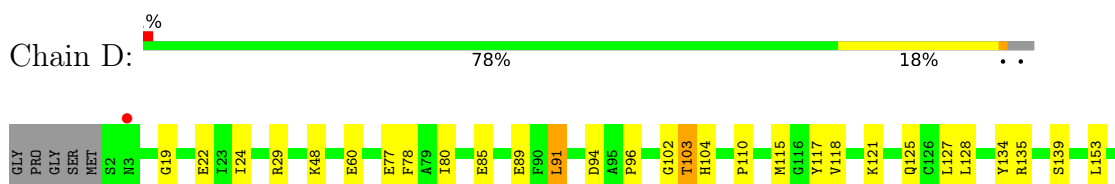
- Molecule 1: Hydroquinone dioxygenase small subunit



- Molecule 1: Hydroquinone dioxygenase small subunit




- Molecule 1: Hydroquinone dioxygenase small subunit



K157
W158
K164


- Molecule 2: Hydroquinone dioxygenase large subunit

Chain W:  80% 14%

MET ALA MET LEU LEU SER SER VAL ASP SER ALA ALA ASP D16 H24 H24 A25 V26 L34 E38 T49 W50 R57 S58 H59 L60 R68 D73 F78 F79 Y101 T117 F120 L124 L124 T140 F144 M161 M175 Q179 R192

H205 F220 L223 S233 A240 P245 E248 H256 I265 D274 D277 D280 G281 N282 P283 V294 P298 L301 R302 H303 R310 T320 L323 P324 H325 S329 K333 P334 I337 E338 F339

- Molecule 2: Hydroquinone dioxygenase large subunit


Chain X:  73% 20%

MET ALA MET LEU LEU SER SER VAL ASP SER ALA ALA ASP D16 L34 I48 K53 R57 L60 D64 R68 M71 G77 F78 F79 W82 V83 N84 H87 R82 N93 Y94 K97 I125 T140 F144 A145 E149 S152

K157 H158 E160 N161 L162 E163 C164 I165 E166 R167 F168 R169 I170 M175 Q179 D180 R185 L188 R192 Q193 P202 H205 A206 A208 G209 F210 F211 G212 F220 V228 S233 S241 P245 T246 T247 E248 L252 P253 H256 G257 M258 E262

S268 I271 D274 D277 K278 D280 R284 A285 R286 T301 R302 H303 S307 R310 M314 P321 N322 L323 E331 E338 F339

- Molecule 2: Hydroquinone dioxygenase large subunit

Chain Y:  80% 14%

MET ALA MET LEU LEU SER SER VAL ASP SER ALA ALA ASP D16 I48 K53 G54 E55 T56 R57 M71 R72 D73 G77 F78 F79 W82 V83 N84 G90 T91 R92 D99 Y101 A102 T108 M115 L124 L133 F144 M161 I165 E166

M175 Q179 R192 Q193 F194 V197 F210 E211 G212 E213 E248 E249 F250 I251 F255 H256 S268 D277 K278 D279 D280 R284 A285 R286 P298 L301 R302 R310 L323 L332 I337 E338 F339

- Molecule 2: Hydroquinone dioxygenase large subunit

Chain Z:  73% 21%

MET ALA MET LEU LEU SER SER VAL ASP SER ALA ALA ASP D16 H24 A25 L39 W50 R57 S58 H59 L60 D64 R68 M70 M71 R72 F85 R92 N93 Y94 G96 K97 T108 T122 P123 I132 L133 R134 T140 F141

F144 S152 K157 H158 G159 I165 R169 M175 P176 Q179 R185 L188 R192 V204 H205 F210 E211 S218 K221 V228 T229 W230 P245 E248 L252 P253 D259 D269 E270 I271 D277 D280 N282 P283 D293 I301

R302	H303	Y306	S307	R310	L313	M314	T320	P321	R322	L323	P324	H325	L326	P336	I337	E338	F339
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4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	77.02Å 181.05Å 186.81Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	40.73 – 2.49 40.73 – 2.49	Depositor EDS
% Data completeness (in resolution range)	95.8 (40.73-2.49) 99.5 (40.73-2.49)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	6.23 (at 2.48Å)	Xtrriage
Refinement program	PHENIX 1.6.4_486	Depositor
R, R_{free}	0.186 , 0.237 0.182 , 0.231	Depositor DCC
R_{free} test set	4606 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å ²)	33.9	Xtrriage
Anisotropy	0.457	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 30.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.007 for -h,l,k	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	16274	wwPDB-VP
Average B, all atoms (Å ²)	33.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.64% 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: H8N, CD

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	0/1298	0.55	0/1757
1	B	0.38	0/1290	0.52	0/1746
1	C	0.39	0/1301	0.52	0/1761
1	D	0.42	0/1290	0.56	0/1746
2	W	0.41	0/2698	0.57	0/3666
2	X	0.41	0/2689	0.55	0/3654
2	Y	0.42	0/2689	0.57	0/3654
2	Z	0.41	0/2687	0.57	0/3651
All	All	0.41	0/15942	0.55	0/21635

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	1269	0	1264	26	0
1	B	1261	0	1259	33	0
1	C	1272	0	1272	28	0
1	D	1261	0	1259	32	0
2	W	2620	0	2472	31	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	X	2611	0	2467	64	0
2	Y	2611	0	2467	36	0
2	Z	2610	0	2466	71	0
3	W	1	0	0	0	0
3	X	1	0	0	0	0
3	Y	1	0	0	0	0
3	Z	1	0	0	0	0
4	W	9	0	5	0	0
4	X	9	0	5	0	0
4	Y	9	0	5	0	0
4	Z	9	0	5	0	0
5	A	63	0	0	0	0
5	B	38	0	0	2	0
5	C	38	0	0	3	0
5	D	65	0	0	2	0
5	W	156	0	0	2	0
5	X	123	0	0	6	0
5	Y	117	0	0	5	0
5	Z	119	0	0	4	0
All	All	16274	0	14946	279	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 279 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:B:48:LYS:HE2	1:B:103:THR:HG21	1.45	0.98
2:X:170:ILE:HD12	2:X:170:ILE:H	1.40	0.86
2:Z:229:THR:HG23	2:Z:230:TRP:CD1	2.13	0.83
1:A:87:ARG:HB3	1:A:137:GLU:HB2	1.61	0.83
1:C:65:GLU:OE2	5:C:201:HOH:O	1.96	0.83

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	162/168 (96%)	158 (98%)	4 (2%)	0	100	100
1	B	161/168 (96%)	157 (98%)	4 (2%)	0	100	100
1	C	162/168 (96%)	157 (97%)	5 (3%)	0	100	100
1	D	161/168 (96%)	156 (97%)	5 (3%)	0	100	100
2	W	324/339 (96%)	307 (95%)	17 (5%)	0	100	100
2	X	323/339 (95%)	304 (94%)	19 (6%)	0	100	100
2	Y	323/339 (95%)	306 (95%)	17 (5%)	0	100	100
2	Z	323/339 (95%)	305 (94%)	18 (6%)	0	100	100
All	All	1939/2028 (96%)	1850 (95%)	89 (5%)	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	134/136 (98%)	126 (94%)	8 (6%)	19	34
1	B	133/136 (98%)	125 (94%)	8 (6%)	19	34
1	C	134/136 (98%)	123 (92%)	11 (8%)	11	20
1	D	133/136 (98%)	127 (96%)	6 (4%)	27	48
2	W	276/284 (97%)	261 (95%)	15 (5%)	22	40
2	X	275/284 (97%)	255 (93%)	20 (7%)	14	25

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	Y	275/284 (97%)	258 (94%)	17 (6%)	18	33
2	Z	275/284 (97%)	257 (94%)	18 (6%)	17	31
All	All	1635/1680 (97%)	1532 (94%)	103 (6%)	18	32

5 of 103 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	X	163	GLU
2	Y	73	ASP
2	Z	280	ASP
2	X	192	ARG
2	X	279	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 25 such sidechains are listed below:

Mol	Chain	Res	Type
2	W	325	HIS
2	X	205	HIS
2	Z	205	HIS
2	X	161	ASN
2	X	322	ASN

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 8 ligands modelled in this entry, 4 are monoatomic - leaving 4 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
4	H8N	X	402	3	9,9,9	1.02	1 (11%)	11,11,11	0.87	0
4	H8N	W	402	3	9,9,9	0.80	1 (11%)	11,11,11	0.90	0
4	H8N	Y	402	3	9,9,9	0.86	1 (11%)	11,11,11	1.02	0
4	H8N	Z	402	3	9,9,9	0.82	1 (11%)	11,11,11	1.14	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
4	H8N	X	402	3	-	0/2/2/2	0/1/1/1
4	H8N	W	402	3	-	0/2/2/2	0/1/1/1
4	H8N	Y	402	3	-	0/2/2/2	0/1/1/1
4	H8N	Z	402	3	-	0/2/2/2	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	X	402	H8N	CAI-CAC	2.50	1.50	1.44
4	Z	402	H8N	CAI-CAC	2.36	1.49	1.44
4	W	402	H8N	CAI-CAC	2.30	1.49	1.44
4	Y	402	H8N	CAI-CAC	2.11	1.49	1.44

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 [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	163/168 (97%)	-0.62	0 100 100	21, 31, 46, 61	0
1	B	163/168 (97%)	-0.34	2 (1%) 79 80	25, 40, 58, 70	0
1	C	163/168 (97%)	-0.36	2 (1%) 79 80	24, 38, 63, 87	0
1	D	163/168 (97%)	-0.59	1 (0%) 89 90	22, 32, 50, 70	0
2	W	324/339 (95%)	-0.51	1 (0%) 94 94	18, 28, 48, 72	0
2	X	324/339 (95%)	-0.36	4 (1%) 79 80	18, 30, 58, 90	0
2	Y	324/339 (95%)	-0.37	0 100 100	17, 29, 51, 74	0
2	Z	324/339 (95%)	-0.50	1 (0%) 94 94	20, 30, 52, 74	0
All	All	1948/2028 (96%)	-0.45	11 (0%) 89 90	17, 31, 54, 90	0

The worst 5 of 11 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	2	SER	5.6
2	X	16	ASP	4.2
2	X	208	GLU	3.4
2	W	280	ASP	3.1
1	C	99	HIS	2.8

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 monosaccharides 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
4	H8N	Z	402	9/9	0.96	0.12	26,28,32,33	0
4	H8N	X	402	9/9	0.97	0.15	17,29,32,33	0
4	H8N	Y	402	9/9	0.97	0.18	13,24,31,36	0
3	CD	Y	401	1/1	0.97	0.09	55,55,55,55	0
3	CD	X	401	1/1	0.99	0.07	49,49,49,49	0
3	CD	Z	401	1/1	0.99	0.08	31,31,31,31	0
4	H8N	W	402	9/9	0.99	0.12	21,23,26,26	0
3	CD	W	401	1/1	1.00	0.07	28,28,28,28	0

6.5 Other polymers [i](#)

There are no such residues in this entry.