W O R L D W I D E

wwPDB

P R O T E I N   D A T A   B A N K

wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 15, 2024 – 01:11 PM EST

PDB ID	:	3Q3M
Title	:	Toluene 4 monooxygenase HD Complex with Inhibitor 4-Bromobenzoate
Authors	:	Acheson, J.F.; Bailey, L.J.; Fox, B.G.
Deposited on	:	2010-12-22
Resolution	:	1.75 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:

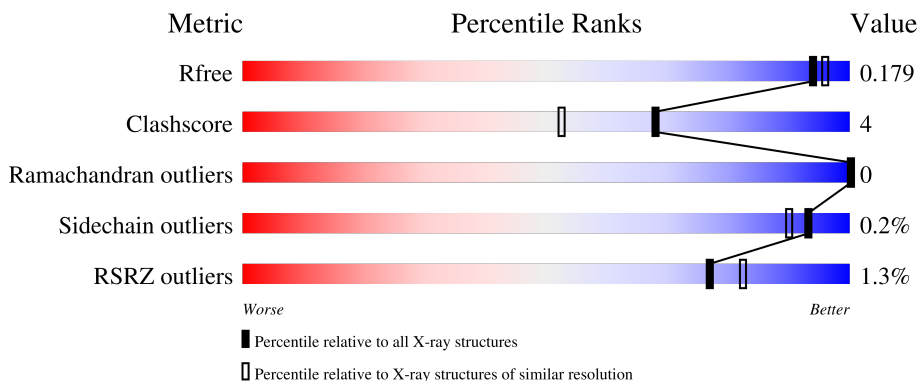|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.75 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.
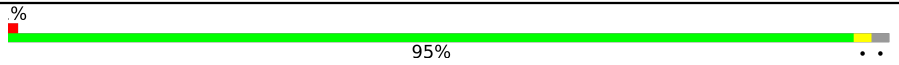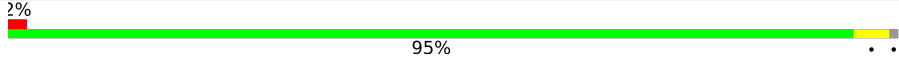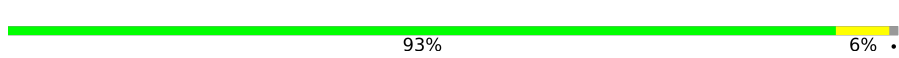
Metric	Percentile Ranks	Value
Rfree		0.179
Clashscore		4
Ramachandran outliers		0
Sidechain outliers		0.2%
RSRZ outliers		1.3%

Worse   *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R$_{free}$	130704	3764 (1.76-1.72)
Clashscore	141614	3923 (1.76-1.72)
Ramachandran outliers	138981	3878 (1.76-1.72)
Sidechain outliers	138945	3878 (1.76-1.72)
RSRZ outliers	127900	3705 (1.76-1.72)

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 <=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	500	% 90% 8% •
1	D	500	% 90% 8% •
2	B	307	2% 96% • •
2	F	307	% 95% 5% •
3	C	84	6% 98% •

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Mol	Chain	Length	Quality of chain
3	G	84	95%
4	E	103	95%
4	H	103	93% 6%

2 Entry composition ⓘ

There are 7 unique types of molecules in this entry. The entry contains 18516 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 Toluene-4-monooxygenase system protein A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	491	Total 4065	C 2603	N 687	O 751	S 24	0	4	0
1	D	491	Total 4127	C 2643	N 697	O 762	S 25	0	12	0

- Molecule 2 is a protein called Toluene-4-monooxygenase system protein E.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	305	Total 2578	C 1629	N 447	O 487	S 15	0	7	0
2	F	305	Total 2601	C 1643	N 452	O 490	S 16	0	9	0

- Molecule 3 is a protein called Toluene-4-monooxygenase system protein B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	82	Total 654	C 412	N 117	O 121	S 4	0	0	0
3	G	82	Total 662	C 416	N 118	O 124	S 4	0	1	0

- Molecule 4 is a protein called Toluene-4-monooxygenase system protein D.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	E	102	Total 815	C 508	N 141	O 163	S 3	0	1	0
4	H	102	Total 815	C 508	N 141	O 163	S 3	0	1	0

- Molecule 5 is FE (III) ION (three-letter code: FE) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	2	Total 2	Fe 2	0	0
5	D	2	Total 2	Fe 2	0	0

- Molecule 6 is 4-bromobenzoic acid (three-letter code: Z82) (formula: $C_7H_5BrO_2$).
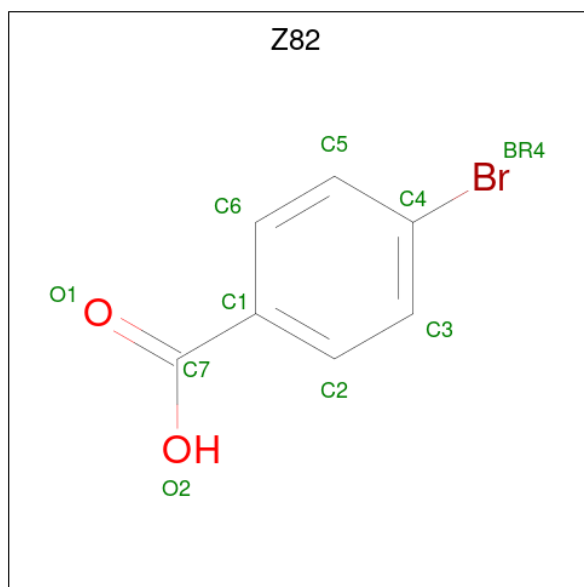
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	A	1	Total 10	Br 1	C 7	O 2	0	0
6	B	1	Total 10	Br 1	C 7	O 2	0	0
6	B	1	Total 10	Br 1	C 7	O 2	0	0
6	E	1	Total 10	Br 1	C 7	O 2	0	0
6	D	1	Total 10	Br 1	C 7	O 2	0	0
6	F	1	Total 10	Br 1	C 7	O 2	0	0
6	H	1	Total 10	Br 1	C 7	O 2	0	0

- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	487	Total 487	O 487	0	0

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| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	B	302	Total 302	O 302	0	0
7	C	74	Total 74	O 74	0	0
7	E	148	Total 148	O 148	0	0
7	D	531	Total 531	O 531	0	0
7	F	357	Total 357	O 357	0	0
7	G	85	Total 85	O 85	0	0
7	H	141	Total 141	O 141	0	0

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.
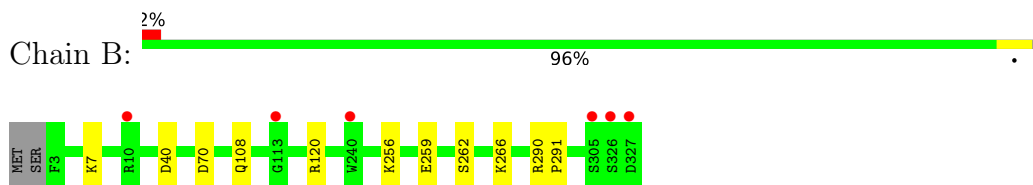
• Molecule 1: Toluene-4-monooxygenase system protein A
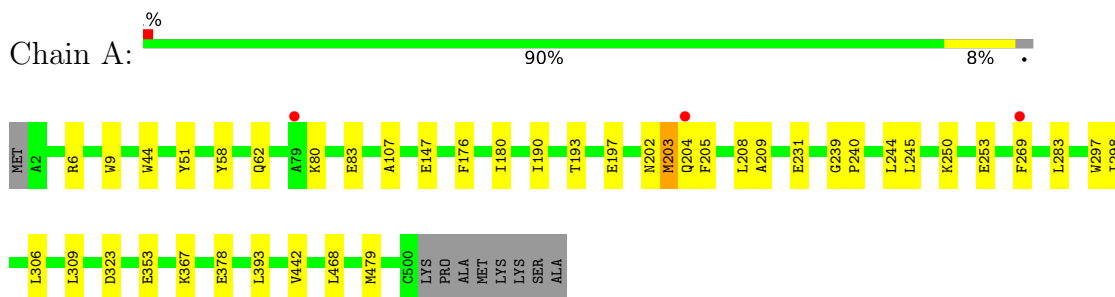
Chain A:

• Molecule 1: Toluene-4-monooxygenase system protein A
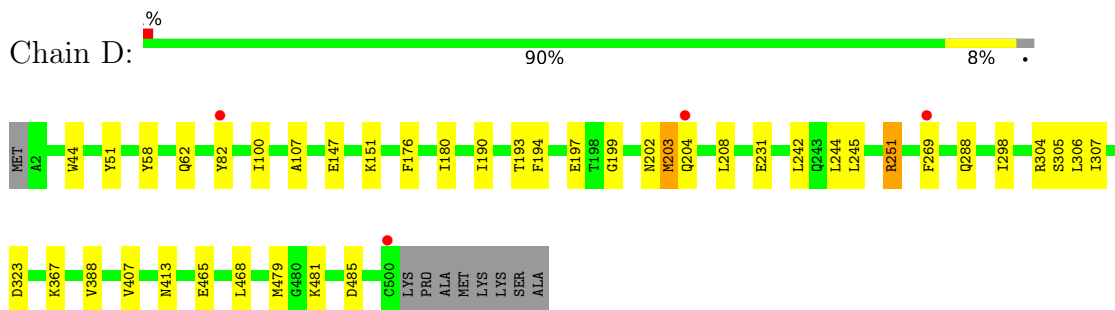
Chain D:

• Molecule 2: Toluene-4-monooxygenase system protein E

Chain B:

• Molecule 2: Toluene-4-monooxygenase system protein E

Chain F:

• Molecule 3: Toluene-4-monooxygenase system protein B

Chain C:

6%

98%

MET S2 A3 F4 E47 G48 V49 D64 E84 GLU

• Molecule 3: Toluene-4-monooxygenase system protein B

Chain G:

%

95%

MET S2 V49 F61 E84 GLU

• Molecule 4: Toluene-4-monooxygenase system protein D

Chain E:

2%

95%

MET S2 T3 L4 Q7 G37 E78 M103

• Molecule 4: Toluene-4-monooxygenase system protein D

Chain H:

93%

6%

MET S2 L9 R46 E78 G86 F99 M103
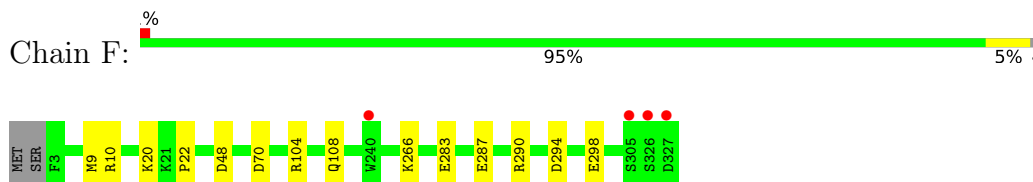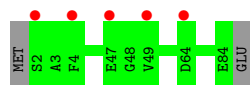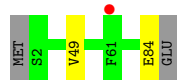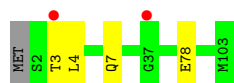
4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	100.04Å 115.72Å 181.28Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.09 – 1.75 48.77 – 1.75	Depositor EDS
% Data completeness (in resolution range)	93.6 (34.09-1.75) 97.6 (48.77-1.75)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.35 (at 1.75Å)	Xtriage
Refinement program	PHENIX 1.6.4_486	Depositor
R, R_{free}	0.143 , 0.178 0.145 , 0.179	Depositor DCC
R_{free} test set	10406 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å^2)	14.9	Xtriage
Anisotropy	0.127	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 52.3	EDS
L-test for twinning[2]	$< |L| > = 0.49, < L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	18516	wwPDB-VP
Average B, all atoms (Å^2)	17.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 57.56 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 2.3267e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $< |L| >$, $< L^2 >$ 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: Z82, FE

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	0.55	0/4194	0.61	1/5694 (0.0%)
1	D	0.55	0/4256	0.62	2/5778 (0.0%)
2	B	0.47	0/2654	0.56	0/3608
2	F	0.53	1/2676 (0.0%)	0.61	0/3634
3	C	0.45	0/666	0.60	0/902
3	G	0.45	0/674	0.56	0/913
4	E	0.53	0/824	0.65	0/1112
4	H	0.49	0/824	0.62	0/1112
All	All	0.52	1/16768 (0.0%)	0.61	3/22753 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	F	9	MET	C-N	-5.25	1.22	1.34

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	D	203	MET	CG-SD-CE	6.93	111.28	100.20
1	D	251	ARG	NE-CZ-NH1	-5.63	117.48	120.30
1	A	203	MET	CG-SD-CE	5.17	108.47	100.20

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	4065	0	3814	41	0
1	D	4127	0	3877	42	0
2	B	2578	0	2445	12	0
2	F	2601	0	2472	16	0
3	C	654	0	649	0	0
3	G	662	0	652	2	0
4	E	815	0	803	3	0
4	H	815	0	803	8	0
5	A	2	0	0	0	0
5	D	2	0	0	0	0
6	A	10	0	4	1	0
6	B	20	0	8	0	0
6	D	10	0	4	2	0
6	E	10	0	4	1	0
6	F	10	0	4	1	0
6	H	10	0	4	1	0
7	A	487	0	0	10	0
7	B	302	0	0	8	0
7	C	74	0	0	0	0
7	D	531	0	0	12	0
7	E	148	0	0	3	0
7	F	357	0	0	7	0
7	G	85	0	0	1	0
7	H	141	0	0	1	0
All	All	18516	0	15543	120	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 4.

The worst 5 of 120 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)
2:F:10:ARG:HH12	2:F:22:PRO:HD3	1.06	1.12
7:D:2014:HOH:O	6:H:104:Z82:BR4	2.21	1.11
1:A:203:MET:HB3	1:A:269:PHE:HZ	1.31	0.95
1:D:203:MET:HB3	1:D:269:PHE:HZ	1.32	0.93
7:D:1653:HOH:O	2:F:48:ASP:HB2	1.69	0.93

There are no symmetry-related clashes.

5.3   Torsion angles ⓘ

5.3.1   Protein backbone ⓘ

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	493/500 (99%)	478 (97%)	15 (3%)	0	100	100
1	D	501/500 (100%)	487 (97%)	14 (3%)	0	100	100
2	B	310/307 (101%)	307 (99%)	3 (1%)	0	100	100
2	F	312/307 (102%)	309 (99%)	3 (1%)	0	100	100
3	C	80/84 (95%)	77 (96%)	3 (4%)	0	100	100
3	G	81/84 (96%)	77 (95%)	4 (5%)	0	100	100
4	E	100/103 (97%)	99 (99%)	1 (1%)	0	100	100
4	H	100/103 (97%)	99 (99%)	1 (1%)	0	100	100
All	All	1977/1988 (99%)	1933 (98%)	44 (2%)	0	100	100

There are no Ramachandran outliers to report.

5.3.2   Protein sidechains ⓘ

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	420/423 (99%)	418 (100%)	2 (0%)	88	83
1	D	428/423 (101%)	426 (100%)	2 (0%)	88	83
2	B	283/278 (102%)	283 (100%)	0	100	100
2	F	285/278 (102%)	285 (100%)	0	100	100
3	C	73/75 (97%)	73 (100%)	0	100	100
3	G	74/75 (99%)	74 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
4	E	87/87 (100%)	87 (100%)	0	100	100
4	H	87/87 (100%)	87 (100%)	0	100	100
All	All	1737/1726 (101%)	1733 (100%)	4 (0%)	93	90

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	51	TYR
1	A	323	ASP
1	D	51	TYR
1	D	323	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	123	ASN
1	D	248	ASN
4	H	13	ASN
1	A	243	GLN
1	A	123	ASN

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 monosaccharides in this entry.

5.6   Ligand geometry ⓘ

Of 11 ligands modelled in this entry, 4 are monoatomic - leaving 7 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
6	Z82	H	104	-	10,10,10	0.88	0	13,13,13	1.21	1 (7%)
6	Z82	A	510	5	10,10,10	1.92	3 (30%)	13,13,13	1.14	1 (7%)
6	Z82	D	511	5	10,10,10	1.88	2 (20%)	13,13,13	1.92	4 (30%)
6	Z82	F	328	-	10,10,10	0.88	0	13,13,13	1.12	1 (7%)
6	Z82	B	328	-	10,10,10	1.16	1 (10%)	13,13,13	0.87	0
6	Z82	E	104	-	10,10,10	1.22	1 (10%)	13,13,13	1.21	0
6	Z82	B	329	-	10,10,10	0.81	0	13,13,13	0.99	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
6	Z82	H	104	-	-	0/4/4/4	0/1/1/1
6	Z82	A	510	5	-	0/4/4/4	0/1/1/1
6	Z82	D	511	5	-	0/4/4/4	0/1/1/1
6	Z82	F	328	-	-	0/4/4/4	0/1/1/1
6	Z82	B	328	-	-	0/4/4/4	0/1/1/1
6	Z82	E	104	-	-	0/4/4/4	0/1/1/1
6	Z82	B	329	-	-	0/4/4/4	0/1/1/1

The worst 5 of 7 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
6	D	511	Z82	O2-C7	-3.88	1.18	1.30
6	A	510	Z82	O2-C7	-3.41	1.20	1.30
6	A	510	Z82	C6-C1	-3.14	1.33	1.39
6	E	104	Z82	BR4-C4	3.09	1.96	1.90
6	B	328	Z82	BR4-C4	2.67	1.95	1.90

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
6	D	511	Z82	C5-C6-C1	-3.19	117.07	120.78
6	D	511	Z82	O2-C7-C1	2.97	122.56	114.85
6	D	511	Z82	C6-C1-C2	2.88	122.68	118.59
6	D	511	Z82	C2-C1-C7	-2.63	115.22	120.39
6	H	104	Z82	C3-C2-C1	-2.33	118.07	120.78

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	H	104	Z82	1	0
6	A	510	Z82	1	0
6	D	511	Z82	2	0
6	F	328	Z82	1	0
6	E	104	Z82	1	0

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(Å²)	Q<0.9
1	A	491/500 (98%)	-0.24	3 (0%)	89	92	7, 13, 26, 40	1 (0%)
1	D	491/500 (98%)	-0.23	4 (0%)	86	90	6, 12, 25, 39	2 (0%)
2	B	305/307 (99%)	-0.14	6 (1%)	65	71	8, 16, 34, 100	2 (0%)
2	F	305/307 (99%)	-0.19	4 (1%)	77	82	7, 13, 28, 104	0
3	C	82/84 (97%)	0.34	5 (6%)	21	25	11, 22, 43, 56	0
3	G	82/84 (97%)	0.18	1 (1%)	79	84	10, 20, 35, 48	1 (1%)
4	E	102/103 (99%)	-0.30	2 (1%)	65	71	7, 13, 28, 43	0
4	H	102/103 (99%)	-0.41	0	100	100	8, 14, 30, 41	0
All	All	1960/1988 (98%)	-0.19	25 (1%)	77	82	6, 14, 30, 104	6 (0%)

The worst 5 of 25 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	F	327	ASP	11.4
2	B	327	ASP	9.4
2	B	10	ARG	4.5
2	B	326	SER	4.3
3	C	2	SER	4.0

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

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

6.3 Carbohydrates ⓘ

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
6	Z82	B	329	10/10	0.90	0.14	24,27,30,46	10
6	Z82	F	328	10/10	0.92	0.16	27,28,32,47	10
6	Z82	B	328	10/10	0.93	0.16	17,20,24,32	10
6	Z82	A	510	10/10	0.96	0.16	10,16,20,20	9
6	Z82	D	511	10/10	0.97	0.16	7,20,22,25	8
6	Z82	E	104	10/10	0.98	0.11	13,14,20,20	10
6	Z82	H	104	10/10	0.99	0.07	10,13,19,19	10
5	FE	D	510	1/1	1.00	0.04	13,13,13,13	0
5	FE	A	870	1/1	1.00	0.05	12,12,12,12	0
5	FE	A	509	1/1	1.00	0.04	14,14,14,14	0
5	FE	D	509	1/1	1.00	0.04	10,10,10,10	0

6.5 Other polymers (i)

There are no such residues in this entry.