W O R L D W I D E
wwPDB
PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report ⓘ

Sep 3, 2023 – 03:19 AM EDT

PDB ID	:	3R6V
Title	:	Crystal structure of aspartase from Bacillus sp. YM55-1 with bound L-aspartate
Authors	:	Fibriansah, G.; Puthan Veetil, V.; Poelarends, G.J.; Thunnissen, A.-M.W.H.
Deposited on	:	2011-03-22
Resolution	:	2.60 Å(reported)

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	:	2.35
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)	:	2.35

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 2.60 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.
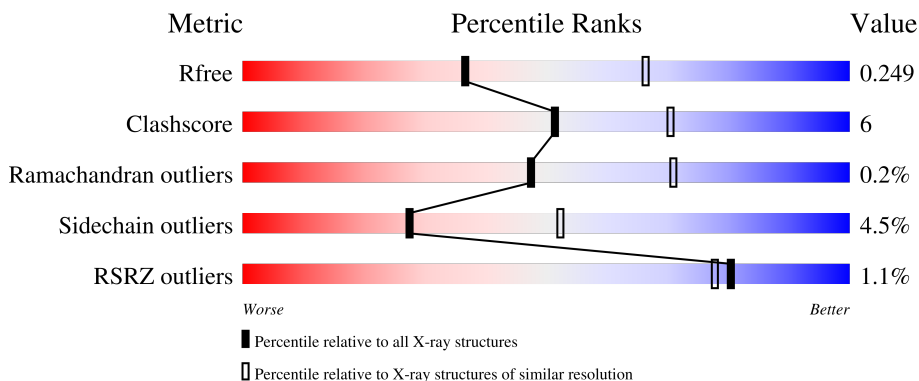
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	3163 (2.60-2.60)
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (2.60-2.60)
RSRZ outliers	127900	3104 (2.60-2.60)

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 <=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	468	3% / 79% / 18% / ..
1	B	468	85% / 13% / ..
1	C	468	86% / 12% / ..
1	D	468	81% / 17% / ..
1	E	468	5% / 83% / 14% / ..

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Mol	Chain	Length	Quality of chain
1	F	468	81% 16%
1	G	468	83% 14%
1	H	468	81% 16%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 28980 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 Aspartase.

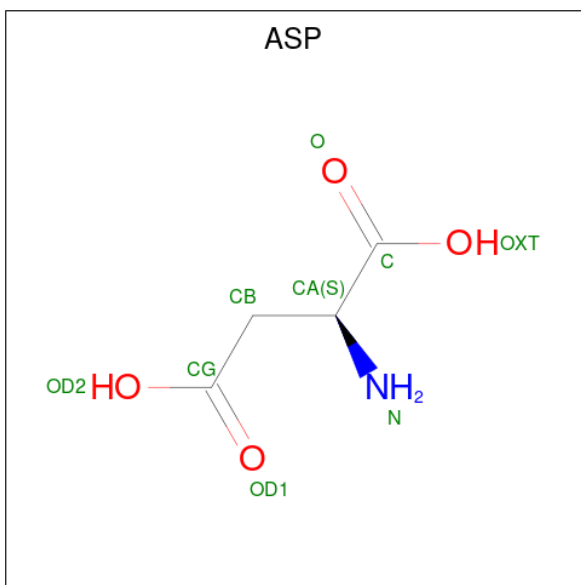| Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	458	Total	C	N	O	S	0	0	0
			3547	2240	600	685	22			
1	B	462	Total	C	N	O	S	0	0	0
			3568	2253	604	689	22			
1	C	462	Total	C	N	O	S	0	0	0
			3568	2253	604	689	22			
1	D	459	Total	C	N	O	S	0	0	0
			3551	2242	601	686	22			
1	E	459	Total	C	N	O	S	0	1	0
			3557	2246	601	688	22			
1	F	461	Total	C	N	O	S	0	0	0
			3564	2251	603	688	22			
1	G	463	Total	C	N	O	S	0	0	0
			3573	2256	605	690	22			
1	H	459	Total	C	N	O	S	0	0	0
			3551	2242	601	686	22			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	460	ILE	THR	conflict	UNP Q9LCC6
B	460	ILE	THR	conflict	UNP Q9LCC6
C	460	ILE	THR	conflict	UNP Q9LCC6
D	460	ILE	THR	conflict	UNP Q9LCC6
E	460	ILE	THR	conflict	UNP Q9LCC6
F	460	ILE	THR	conflict	UNP Q9LCC6
G	460	ILE	THR	conflict	UNP Q9LCC6
H	460	ILE	THR	conflict	UNP Q9LCC6

- Molecule 2 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total 1	Ca 1	0	0
2	D	1	Total 1	Ca 1	0	0
2	E	1	Total 1	Ca 1	0	0
2	H	1	Total 1	Ca 1	0	0

- Molecule 3 is ASPARTIC ACID (three-letter code: ASP) (formula: $C_4H_7NO_4$).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	B	1	Total 9	C 4	N 1	O 4	0	0
3	F	1	Total 9	C 4	N 1	O 4	0	0

- Molecule 4 is water.

| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	74	Total 74	O 74	0	0
4	B	58	Total 58	O 58	0	0
4	C	50	Total 50	O 50	0	0
4	D	71	Total 71	O 71	0	0

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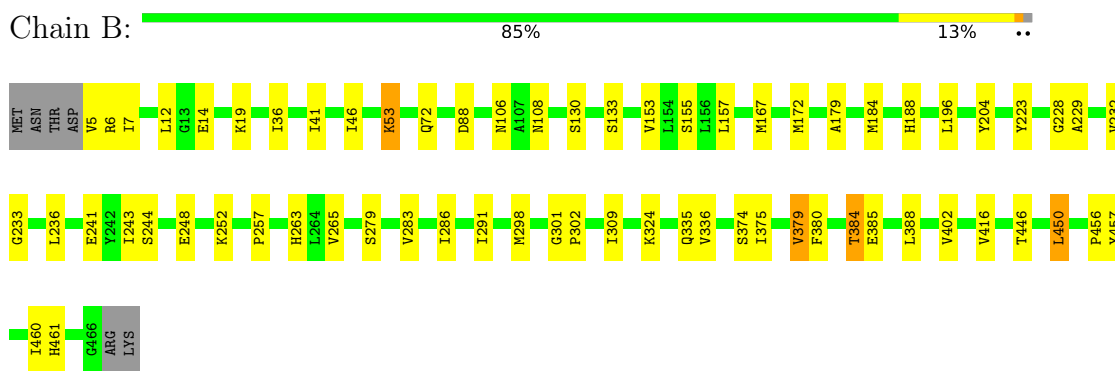| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	E	55	Total 55	O 55	0	0
4	F	66	Total 66	O 66	0	0
4	G	41	Total 41	O 41	0	0
4	H	64	Total 64	O 64	0	0

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.

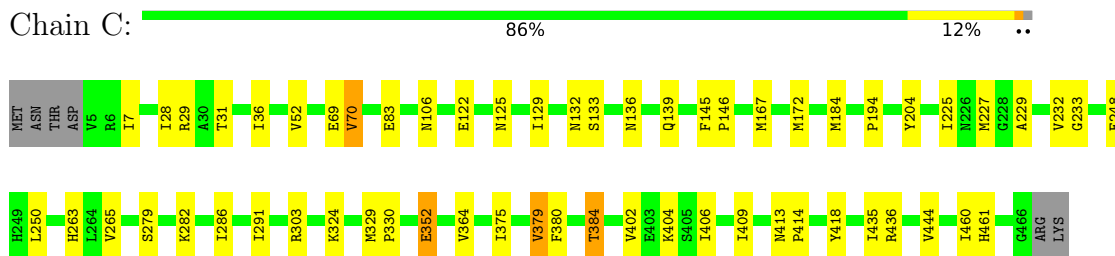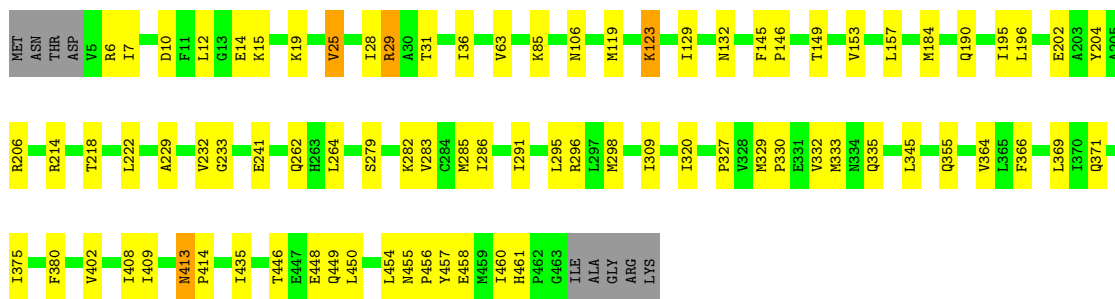• Molecule 1: Aspartase

Chain A:

• Molecule 1: Aspartase

Chain B:

• Molecule 1: Aspartase

Chain C:
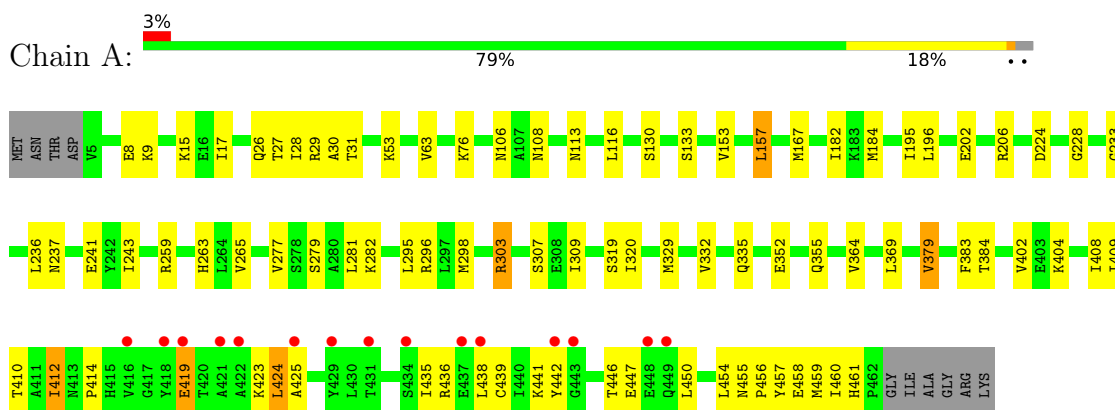
• Molecule 1: Aspartase

Chain D:

• Molecule 1: Aspartase

Chain E:

• Molecule 1: Aspartase

Chain F:

• Molecule 1: Aspartase

Chain G:

E419 T420 V444 L445 T446 E447 P456 Y457 I460 G466 ARG LYS

• Molecule 1: Aspartase

Chain H:

81% 16%

MET ASN THR ASP V5 R6 I7 D10 E14 K19 Q26 R29 I36 N106 E109 M119 S127 K128 I129 S130 S133 E162 M167 M172 K173 K174 A179 I182 K183 M184 Q190 P194 I195 L196 E202 A203 Y204 A205 R206 R214

T218 R219 N220 Y223 D224 G228 A229 V232 G233 E241 Y242 I243 R259 H263 L264 V265 S279 K282 K290 I291 R296 L297 M298 S307 E308 I309 K324 P327 V328 M329 P330 Q335 L345 E352 A353 G354 Q355 F356 E357 M361 F383

T384 L388 K399 V402 E403 I409 N413 P414 T420 R426 I435 V444 L445 T446 I460 H461 P462 G463 ILE ALA GLY ARG LYS

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α, β, γ	75.85Å 118.96Å 141.41Å 89.93° 89.93° 76.42°	Depositor
Resolution (Å)	39.73 – 2.60 39.73 – 2.60	Depositor EDS
% Data completeness (in resolution range)	97.9 (39.73-2.60) 97.5 (39.73-2.60)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.11	Depositor
$< I/\sigma(I) >$ [1]	1.98 (at 2.61Å)	Xtriage
Refinement program	REFMAC 5.5.0102	Depositor
R, R_{free}	0.193 , 0.250 0.195 , 0.249	Depositor DCC
R_{free} test set	7250 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å^2)	33.5	Xtriage
Anisotropy	0.166	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , -0.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.49, < L^2 > = 0.32$	Xtriage
Estimated twinning fraction	0.457 for -h,-k,l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	28980	wwPDB-VP
Average B, all atoms (Å^2)	34.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.83% of the height of the origin peak. No significant pseudotranslation is detected.*

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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: CA

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	0.47	0/3606	0.59	0/4880
1	B	0.48	0/3627	0.57	0/4908
1	C	0.47	0/3627	0.57	0/4908
1	D	0.49	0/3610	0.58	0/4885
1	E	0.46	0/3619	0.57	1/4897 (0.0%)
1	F	0.47	0/3623	0.58	0/4903
1	G	0.46	0/3632	0.57	0/4915
1	H	0.48	0/3610	0.58	0/4885
All	All	0.47	0/28954	0.57	1/39181 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	E	296	ARG	NE-CZ-NH2	-6.13	117.24	120.30

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	3547	0	3563	52	0
1	B	3568	0	3585	39	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	C	3568	0	3585	32	0
1	D	3551	0	3566	50	0
1	E	3557	0	3572	44	0
1	F	3564	0	3582	49	0
1	G	3573	0	3587	47	0
1	H	3551	0	3566	47	0
2	A	1	0	0	0	0
2	D	1	0	0	0	0
2	E	1	0	0	0	0
2	H	1	0	0	0	0
3	B	9	0	3	0	0
3	F	9	0	3	0	0
4	A	74	0	0	0	0
4	B	58	0	0	0	0
4	C	50	0	0	1	0
4	D	71	0	0	0	0
4	E	55	0	0	0	0
4	F	66	0	0	0	0
4	G	41	0	0	2	0
4	H	64	0	0	1	0
All	All	28980	0	28612	320	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 6.

The worst 5 of 320 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:53:LYS:HE2	1:A:108:ASN:OD1	1.75	0.87
1:F:460:ILE:HD12	1:F:461:HIS:ND1	1.92	0.84
1:D:229:ALA:HB1	1:D:233:GLY:HA2	1.61	0.82
1:B:184:MET:HE2	1:B:402:VAL:HG22	1.62	0.81
1:A:184:MET:CE	1:A:402:VAL:HA	2.13	0.77

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	456/468 (97%)	440 (96%)	13 (3%)	3 (1%)	22	43
1	B	460/468 (98%)	444 (96%)	16 (4%)	0	100	100
1	C	460/468 (98%)	449 (98%)	11 (2%)	0	100	100
1	D	457/468 (98%)	442 (97%)	14 (3%)	1 (0%)	47	71
1	E	458/468 (98%)	439 (96%)	16 (4%)	3 (1%)	22	43
1	F	459/468 (98%)	440 (96%)	19 (4%)	0	100	100
1	G	461/468 (98%)	450 (98%)	11 (2%)	0	100	100
1	H	457/468 (98%)	442 (97%)	15 (3%)	0	100	100
All	All	3668/3744 (98%)	3546 (97%)	115 (3%)	7 (0%)	47	71

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	419	GLU
1	E	419	GLU
1	A	414	PRO
1	E	456	PRO
1	A	447	GLU

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	387/394 (98%)	365 (94%)	22 (6%)	20	41

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	388/394 (98%)	371 (96%)	17 (4%)	28	53
1	C	388/394 (98%)	372 (96%)	16 (4%)	30	56
1	D	387/394 (98%)	369 (95%)	18 (5%)	26	50
1	E	388/394 (98%)	370 (95%)	18 (5%)	27	51
1	F	388/394 (98%)	373 (96%)	15 (4%)	32	58
1	G	388/394 (98%)	368 (95%)	20 (5%)	23	46
1	H	387/394 (98%)	372 (96%)	15 (4%)	32	58
All	All	3101/3152 (98%)	2960 (96%)	141 (4%)	27	52

5 of 141 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	G	172	MET
1	G	379	VAL
1	H	172	MET
1	C	248	GLU
1	C	172	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	26	GLN
1	G	326	ASN
1	E	96	GLN
1	G	413	ASN
1	E	451	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 6 ligands modelled in this entry, 4 are monoatomic - leaving 2 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	#$|Z| > 2$
3	ASP	F	469	-	6,8,8	1.14	1 (16%)	8,10,10	1.29	1 (12%)
3	ASP	B	469	-	6,8,8	1.12	0	8,10,10	1.28	1 (12%)

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
3	ASP	F	469	-	-	4/8/8/8	-
3	ASP	B	469	-	-	3/8/8/8	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	F	469	ASP	OXT-C	-2.00	1.24	1.30

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	F	469	ASP	OXT-C-CA	2.11	120.56	113.38
3	B	469	ASP	OXT-C-O	-2.02	119.50	124.09

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	F	469	ASP	C-CA-CB-CG
3	F	469	ASP	N-CA-CB-CG
3	F	469	ASP	OXT-C-CA-N
3	B	469	ASP	OXT-C-CA-N
3	B	469	ASP	O-C-CA-N

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 (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	458/468 (97%)	-0.60	15 (3%)	46	39	16, 27, 120, 131	0
1	B	462/468 (98%)	-0.80	0	100	100	16, 31, 53, 63	0
1	C	462/468 (98%)	-0.74	0	100	100	18, 33, 60, 78	0
1	D	459/468 (98%)	-0.84	0	100	100	16, 27, 50, 58	0
1	E	459/468 (98%)	-0.54	25 (5%)	25	20	13, 27, 120, 131	0
1	F	461/468 (98%)	-0.79	0	100	100	18, 31, 52, 65	0
1	G	463/468 (98%)	-0.69	0	100	100	18, 34, 60, 81	0
1	H	459/468 (98%)	-0.84	0	100	100	16, 27, 51, 59	0
All	All	3683/3744 (98%)	-0.73	40 (1%)	80	78	13, 29, 61, 131	0

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	442	TYR	4.3
1	A	443	GLY	4.3
1	E	448	GLU	4.0
1	E	429	TYR	3.9
1	A	418	TYR	3.9

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 ⓘ

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	CA	E	469	1/1	0.92	0.06	67,67,67,67	0
3	ASP	F	469	9/9	0.94	0.18	42,42,43,43	0
3	ASP	B	469	9/9	0.95	0.17	42,43,44,44	0
2	CA	D	469	1/1	0.95	0.09	43,43,43,43	0
2	CA	H	469	1/1	0.96	0.10	49,49,49,49	0
2	CA	A	469	1/1	0.97	0.10	55,55,55,55	0

6.5   Other polymers ⓘ

There are no such residues in this entry.