



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 08:16 PM EDT

PDB ID : 7BEU / pdb_00007beu
Title : Human glutathione transferase M1-1
Authors : Papageorgiou, A.C.; Poudel, N.
Deposited on : 2020-12-28
Resolution : 1.59 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
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

i

X-RAY DIFFRACTION

A.

Metric	Percentile Rank	Value
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Whole archive
(#Entries)

Quality of chain

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 8414 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 Glutathione S-transferase Mu 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	218	Total	C	N	O	S	0	1	0
			1817	1182	297	326	12			
1	B	218	Total	C	N	O	S	0	0	0
			1812	1179	296	325	12			
1	C	218	Total	C	N	O	S	0	1	0
			1817	1184	296	325	12			
1	D	218	Total	C	N	O	S	0	0	0
			1812	1179	296	325	12			

- Molecule 2 is SODIUM ION (CCD ID: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Na	0	0
			1	1		
2	B	4	Total	Na	0	0
			4	4		
2	C	2	Total	Na	0	0
			2	2		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	318	Total	O	0	0
			318	318		
3	B	247	Total	O	0	0
			247	247		
3	C	379	Total	O	0	0
			379	379		
3	D	205	Total	O	0	0
			205	205		

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: Glutathione S-transferase Mu 1

Chain A:  89% 11%



- Molecule 1: Glutathione S-transferase Mu 1

Chain B:  91% 9%



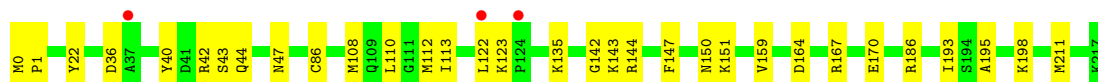
- Molecule 1: Glutathione S-transferase Mu 1

Chain C:  91% 9%



- Molecule 1: Glutathione S-transferase Mu 1

Chain D:  85% 15%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	49.12Å 211.19Å 49.44Å 90.00° 116.23° 90.00°	Depositor
Resolution (Å)	52.80 – 1.59 52.80 – 1.59	Depositor EDS
% Data completeness (in resolution range)	93.4 (52.80-1.59) 92.4 (52.80-1.59)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.69 (at 1.59Å)	Xtriage
Refinement program	PHENIX 1.17.1_3660	Depositor
R, R_{free}	0.188 , 0.226 0.189 , 0.227	Depositor DCC
R_{free} test set	5544 reflections (4.62%)	wwPDB-VP
Wilson B-factor (Å ²)	20.7	Xtriage
Anisotropy	0.198	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 31.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	0.208 for l,-k,h	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	8414	wwPDB-VP
Average B, all atoms (Å ²)	27.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.57% 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:
NA

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	0.29	0/1869	0.51	0/2519
1	B	0.25	0/1861	0.47	0/2508
1	C	0.31	0/1869	0.52	0/2519
1	D	0.25	0/1861	0.49	0/2508
All	All	0.28	0/7460	0.50	0/10054

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	1817	0	1810	20	0
1	B	1812	0	1804	16	0
1	C	1817	0	1815	19	0
1	D	1812	0	1804	36	0
2	A	1	0	0	0	0
2	B	4	0	0	0	0
2	C	2	0	0	0	0
3	A	318	0	0	6	1
3	B	247	0	0	9	5

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	379	0	0	11	2
3	D	205	0	0	14	5
All	All	8414	0	7233	90	9

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.

All (90) 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:D:108:MET:HG3	1:D:112:MET:HE1	1.45	0.99
1:D:0:MET:O	3:D:301:HOH:O	1.85	0.94
1:D:36:ASP:O	3:D:302:HOH:O	1.88	0.91
1:B:197:MET:SD	3:B:605:HOH:O	2.30	0.87
1:D:151:LYS:HG2	3:D:458:HOH:O	1.77	0.83
1:D:86:CYS:O	3:D:303:HOH:O	1.96	0.82
1:D:150:ASN:ND2	3:D:305:HOH:O	2.11	0.82
1:D:123:LYS:NZ	3:D:306:HOH:O	2.12	0.80
1:D:108:MET:HG3	1:D:112:MET:CE	2.14	0.76
1:A:125:LYS:NZ	3:A:403:HOH:O	2.20	0.74
1:D:170:GLU:OE2	3:D:304:HOH:O	2.05	0.74
1:C:125:LYS:HG2	3:C:708:HOH:O	1.88	0.72
1:D:44:GLN:H	1:D:44:GLN:CD	1.98	0.72
1:B:150:ASN:ND2	3:B:404:HOH:O	2.23	0.72
1:B:216:ASN:ND2	3:B:405:HOH:O	2.25	0.69
1:D:144:ARG:NH1	3:D:308:HOH:O	2.26	0.68
1:A:125:LYS:HG2	3:A:692:HOH:O	1.94	0.68
1:B:48:GLU:OE2	3:B:401:HOH:O	2.11	0.68
1:C:146:TRP:CE2	1:C:152[B]:ILE:HG12	2.28	0.67
1:C:181:LYS:NZ	3:C:407:HOH:O	2.28	0.67
1:D:108:MET:CG	1:D:112:MET:CE	2.73	0.67
1:D:40:TYR:N	3:D:302:HOH:O	2.25	0.66
1:C:0:MET:O	3:C:401:HOH:O	2.14	0.66
1:B:86:CYS:O	3:B:402:HOH:O	2.14	0.65
1:A:34:MET:HE2	1:A:40:TYR:HB3	1.77	0.65
1:A:150[A]:ASN:ND2	3:A:406:HOH:O	2.30	0.65
1:C:128:GLU:OE1	3:C:402:HOH:O	2.15	0.64
1:C:135:LYS:NZ	3:C:410:HOH:O	2.31	0.63
1:A:145:PRO:HB3	1:C:198:LYS:HE2	1.81	0.63
1:D:113:ILE:HD11	1:D:122:LEU:HB3	1.79	0.62
1:D:108:MET:HG2	1:D:112:MET:HE2	1.82	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:198:LYS:HD3	3:D:483:HOH:O	2.03	0.59
1:C:217:LYS:O	3:C:403:HOH:O	2.16	0.59
1:C:0:MET:N	3:C:413:HOH:O	2.36	0.58
1:A:128:GLU:OE1	3:A:401:HOH:O	2.16	0.58
1:C:107:HIS:HD2	1:C:108:MET:HE2	1.69	0.58
1:A:39:ASP:OD2	3:A:402:HOH:O	2.17	0.57
1:D:110:LEU:O	1:D:113:ILE:HG22	2.06	0.56
1:D:43:SER:HB2	3:D:337:HOH:O	2.06	0.55
1:A:202:PHE:CE2	1:A:204:PRO:HG3	2.41	0.55
1:C:107:HIS:CD2	1:C:108:MET:HE2	2.42	0.55
1:D:42:ARG:CZ	1:D:211:MET:HE1	2.36	0.55
1:D:108:MET:CG	1:D:112:MET:HE2	2.36	0.54
1:C:42:ARG:NH2	3:C:411:HOH:O	2.35	0.54
1:B:125:LYS:HE3	3:B:580:HOH:O	2.06	0.54
1:A:7:TRP:HH2	1:A:42:ARG:HB3	1.71	0.54
1:A:108:MET:O	1:A:112:MET:HG3	2.09	0.53
1:D:44:GLN:HB3	3:D:457:HOH:O	2.09	0.52
1:A:48:GLU:HG3	3:A:520:HOH:O	2.09	0.52
1:D:164:ASP:HA	1:D:167:ARG:HG2	1.92	0.52
1:D:0:MET:N	1:D:1:PRO:HD2	2.27	0.50
1:D:144:ARG:CZ	3:D:308:HOH:O	2.59	0.50
1:B:162:VAL:HG23	3:B:524:HOH:O	2.12	0.49
1:C:198:LYS:HG3	3:C:405:HOH:O	2.11	0.49
1:B:123:LYS:HE2	1:B:127:LEU:HD11	1.95	0.48
1:D:43:SER:OG	1:D:47:ASN:ND2	2.46	0.48
1:C:146:TRP:CH2	1:C:186:ARG:HG2	2.48	0.48
1:D:195:ALA:O	1:D:198:LYS:HG2	2.15	0.47
1:B:170:GLU:OE2	3:B:403:HOH:O	2.20	0.47
1:B:112:MET:HA	1:B:112:MET:HE2	1.96	0.46
1:A:32:TYR:HD1	1:A:44:GLN:HG2	1.80	0.46
1:A:123:LYS:HE2	1:A:127:LEU:HD11	1.98	0.46
1:B:42:ARG:HH21	1:B:211:MET:HE1	1.81	0.46
1:D:142:GLY:C	1:D:143:LYS:HE2	2.41	0.46
1:D:147:PHE:CZ	1:D:159:VAL:HG11	2.52	0.45
1:C:217:LYS:NZ	3:C:421:HOH:O	2.50	0.45
1:B:34:MET:HE2	1:B:42:ARG:HG2	1.98	0.45
1:A:34:MET:HE1	1:A:211:MET:HE2	1.99	0.44
1:C:122:LEU:O	1:C:125:LYS:HG3	2.17	0.44
1:D:186:ARG:HD2	3:D:394:HOH:O	2.16	0.44
1:A:122:LEU:O	1:A:125:LYS:HE3	2.18	0.43
1:D:44:GLN:CD	1:D:44:GLN:N	2.73	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:22:TYR:HB2	1:D:193:ILE:HD11	2.01	0.43
1:B:181:LYS:NZ	3:B:408:HOH:O	2.34	0.42
1:A:40:TYR:O	1:A:42:ARG:HG3	2.19	0.42
1:A:147:PHE:CZ	1:A:159:VAL:HG11	2.54	0.42
1:C:40:TYR:CG	1:C:211:MET:HG2	2.54	0.42
1:B:9:ILE:HG22	1:B:206:PRO:HG2	2.01	0.42
1:A:112:MET:HE2	1:A:112:MET:HB3	1.86	0.41
1:D:113:ILE:CD1	1:D:122:LEU:HB3	2.49	0.41
1:D:113:ILE:HD11	1:D:122:LEU:CB	2.47	0.41
1:A:159:VAL:HA	1:A:162:VAL:HG22	2.03	0.41
1:C:147:PHE:CZ	1:C:159:VAL:HG11	2.56	0.41
1:C:112:MET:HG3	3:C:683:HOH:O	2.22	0.40
1:D:42:ARG:HA	1:D:44:GLN:NE2	2.36	0.40
1:B:147:PHE:CZ	1:B:159:VAL:HG11	2.57	0.40
1:B:147:PHE:CE2	1:B:159:VAL:HG11	2.56	0.40
1:D:42:ARG:NH1	1:D:211:MET:HE1	2.37	0.40
1:A:113:ILE:HG13	1:A:114:CYS:N	2.35	0.40
1:D:108:MET:CG	1:D:112:MET:HE1	2.28	0.40

All (9) 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)
3:B:426:HOH:O	3:D:461:HOH:O[2_745]	1.94	0.26
3:B:604:HOH:O	3:D:422:HOH:O[2_745]	2.03	0.17
3:A:609:HOH:O	3:A:692:HOH:O[1_554]	2.06	0.14
3:C:675:HOH:O	3:C:752:HOH:O[1_454]	2.07	0.13
3:B:628:HOH:O	3:D:454:HOH:O[2_746]	2.11	0.09
3:B:401:HOH:O	3:B:416:HOH:O[1_556]	2.12	0.08
3:B:632:HOH:O	3:D:479:HOH:O[2_746]	2.12	0.08
3:D:327:HOH:O	3:D:447:HOH:O[1_455]	2.16	0.04
3:C:404:HOH:O	3:C:651:HOH:O[1_656]	2.17	0.03

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	217/218 (100%)	214 (99%)	3 (1%)	0	100	100
1	B	216/218 (99%)	214 (99%)	2 (1%)	0	100	100
1	C	217/218 (100%)	215 (99%)	2 (1%)	0	100	100
1	D	216/218 (99%)	212 (98%)	4 (2%)	0	100	100
All	All	866/872 (99%)	855 (99%)	11 (1%)	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	198/197 (100%)	198 (100%)	0	100	100
1	B	197/197 (100%)	196 (100%)	1 (0%)	81	70
1	C	198/197 (100%)	198 (100%)	0	100	100
1	D	197/197 (100%)	196 (100%)	1 (0%)	81	70
All	All	790/788 (100%)	788 (100%)	2 (0%)	86	78

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	100	GLU
1	D	135	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (11) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	102	GLN
1	A	106	ASN
1	B	84	ASN

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Mol	Chain	Res	Type
1	B	101	ASN
1	B	106	ASN
1	B	150	ASN
1	C	101	ASN
1	C	106	ASN
1	D	47	ASN
1	D	71	GLN
1	D	106	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 7 ligands modelled in this entry, 7 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 ⓘ

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	218/218 (100%)	-0.96	1 (0%) 87 90	12, 22, 39, 81	1 (0%)
1	B	218/218 (100%)	-0.82	1 (0%) 87 90	15, 26, 47, 97	0
1	C	218/218 (100%)	-1.04	0 100 100	11, 19, 33, 71	1 (0%)
1	D	218/218 (100%)	-0.68	3 (1%) 73 78	14, 28, 55, 83	0
All	All	872/872 (100%)	-0.88	5 (0%) 85 88	11, 23, 47, 97	2 (0%)

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	38	PRO	2.3
1	D	122	LEU	2.3
1	A	0	MET	2.1
1	D	124	PRO	2.1
1	D	37	ALA	2.1

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	NA	B	304	1/1	0.95	0.07	65,65,65,65	0
2	NA	B	303	1/1	0.98	0.04	43,43,43,43	0
2	NA	B	302	1/1	0.98	0.04	34,34,34,34	0
2	NA	C	301	1/1	0.98	0.09	41,41,41,41	0
2	NA	C	302	1/1	0.98	0.10	37,37,37,37	0
2	NA	B	301	1/1	0.99	0.07	37,37,37,37	0
2	NA	A	301	1/1	0.99	0.04	35,35,35,35	0

6.5 Other polymers [i](#)

There are no such residues in this entry.