



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 04:53 PM UTC

PDB ID : 22GS / pdb_000022gs
Title : HUMAN GLUTATHIONE S-TRANSFERASE P1-1 Y49F MUTANT
Authors : Oakley, A.J.
Deposited on : 1998-03-10
Resolution : 1.90 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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

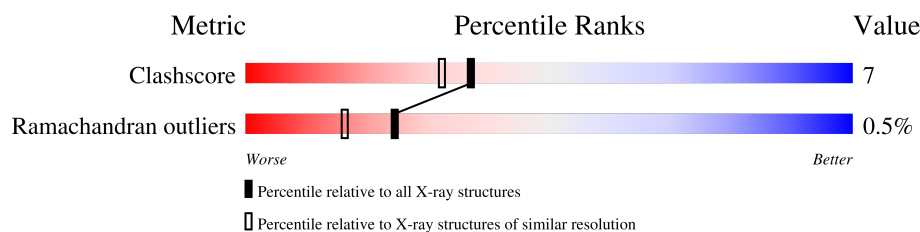
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	210	 81% 17% ..
1	B	210	 82% 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	MES	A	211	-	X	-	-

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 3608 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.

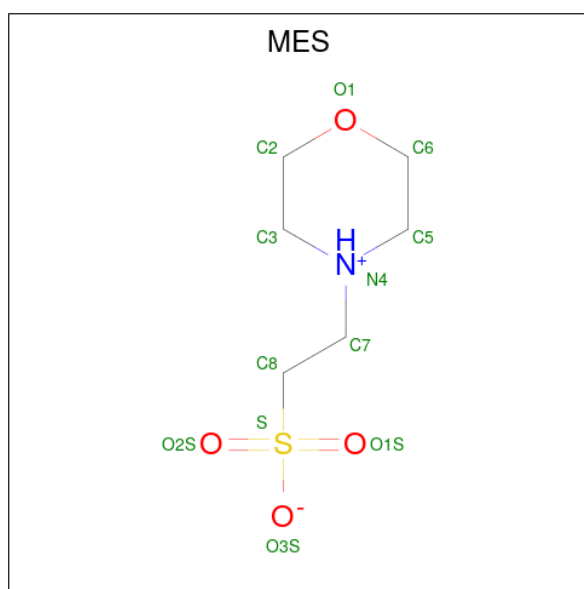
- Molecule 1 is a protein called GLUTATHIONE S-TRANSFERASE P1-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	208	Total	C	N	O	S	0	0	0
			1630	1047	271	306	6			
1	B	208	Total	C	N	O	S	0	0	0
			1630	1047	271	306	6			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	49	PHE	TYR	engineered mutation	UNP P09211
B	49	PHE	TYR	engineered mutation	UNP P09211

- Molecule 2 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: $C_6H_{13}NO_4S$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	S	0	0
			12	6	1	4	1		
2	B	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 3 is water.

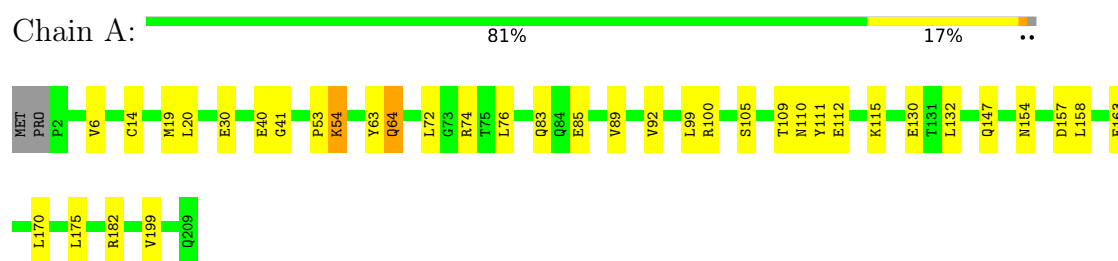
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	152	Total	O	0	0
			152	152		
3	B	160	Total	O	0	0
			160	160		

3 Residue-property plots [i](#)

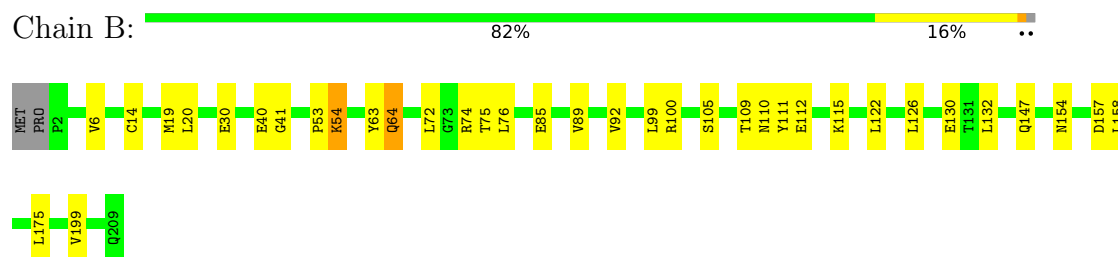
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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. 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.

Note EDS was not executed.

• Molecule 1: GLUTATHIONE S-TRANSFERASE P1-1



• Molecule 1: GLUTATHIONE S-TRANSFERASE P1-1



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α , β , γ	77.76Å 89.96Å 68.89Å 90.00° 97.90° 90.00°	Depositor
Resolution (Å)	15.00 – 1.90	Depositor
% Data completeness (in resolution range)	94.9 (15.00-1.90)	Depositor
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR 3.851	Depositor
R, R_{free}	0.206 , 0.230	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3608	wwPDB-VP
Average B, all atoms (Å ²)	16.0	wwPDB-VP

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: MES

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	0.43	0/1664	0.85	4/2255 (0.2%)
1	B	0.45	0/1664	0.86	4/2255 (0.2%)
All	All	0.44	0/3328	0.86	8/4510 (0.2%)

There are no bond length outliers.

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	199	VAL	N-CA-C	6.12	116.86	110.62
1	A	54	LYS	N-CA-C	-5.93	99.74	109.40
1	A	199	VAL	N-CA-C	5.69	116.42	110.62
1	B	54	LYS	N-CA-C	-5.63	100.23	109.40
1	A	41	GLY	N-CA-C	5.51	121.42	114.25
1	B	41	GLY	N-CA-C	5.39	121.25	114.25
1	A	40	GLU	N-CA-C	-5.08	105.74	111.28
1	B	40	GLU	N-CA-C	-5.03	105.80	111.28

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	1630	0	1634	23	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	B	1630	0	1634	24	0
2	A	24	0	26	4	0
2	B	12	0	13	1	0
3	A	152	0	0	3	0
3	B	160	0	0	3	0
All	All	3608	0	3307	47	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 7.

All (47) 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:A:211:MES:H21	1:B:74:ARG:HH11	1.35	0.92
1:B:105:SER:O	1:B:109:THR:HB	1.86	0.74
1:A:105:SER:O	1:A:109:THR:HB	1.89	0.71
1:B:147:GLN:HG3	3:B:223:HOH:O	1.91	0.71
1:B:63:TYR:O	1:B:64:GLN:HB2	1.96	0.66
1:A:147:GLN:HG3	3:A:240:HOH:O	1.96	0.66
1:B:74:ARG:NH2	3:B:277:HOH:O	2.32	0.61
1:A:63:TYR:O	1:A:64:GLN:HB2	2.00	0.61
1:B:6:VAL:HB	1:B:54:LYS:HB3	1.82	0.60
1:A:6:VAL:HB	1:A:54:LYS:HB3	1.83	0.59
2:A:211:MES:H21	1:B:74:ARG:NH1	2.13	0.59
1:A:74:ARG:NH2	3:A:248:HOH:O	2.36	0.58
1:A:163:GLU:OE2	1:A:170:LEU:HB2	2.04	0.57
1:B:30:GLU:HG2	2:B:210:MES:H22	1.86	0.56
2:A:211:MES:H61	3:B:326:HOH:O	2.07	0.55
1:B:92:VAL:HG22	1:B:132:LEU:HD13	1.92	0.51
1:A:30:GLU:HG2	2:A:210:MES:H22	1.91	0.51
1:A:72:LEU:O	1:A:76:LEU:HB2	2.10	0.51
1:A:100:ARG:HH21	1:A:154:ASN:ND2	2.09	0.50
1:B:110:ASN:HD22	1:B:110:ASN:N	2.10	0.50
1:B:72:LEU:O	1:B:76:LEU:HB2	2.11	0.50
1:B:63:TYR:O	1:B:64:GLN:CB	2.58	0.50
1:B:100:ARG:HH21	1:B:154:ASN:ND2	2.11	0.49
1:A:92:VAL:HG22	1:A:132:LEU:HD13	1.94	0.48
1:A:111:TYR:CZ	1:A:115:LYS:HD2	2.49	0.48
1:A:63:TYR:O	1:A:64:GLN:CB	2.62	0.47
1:B:111:TYR:CZ	1:B:115:LYS:HD2	2.50	0.47
1:A:14:CYS:SG	1:A:53:PRO:HB3	2.55	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:110:ASN:HD22	1:A:110:ASN:N	2.13	0.47
1:A:85:GLU:O	1:A:89:VAL:HG23	2.14	0.46
1:A:99:LEU:HD23	1:A:158:LEU:HD21	1.98	0.45
1:B:85:GLU:O	1:B:89:VAL:HG23	2.18	0.44
1:B:111:TYR:CE1	1:B:115:LYS:HD2	2.54	0.43
1:A:19:MET:HE2	1:A:157:ASP:HB2	2.00	0.43
1:B:14:CYS:SG	1:B:53:PRO:HB3	2.59	0.43
1:B:20:LEU:C	1:B:20:LEU:HD23	2.43	0.43
1:B:99:LEU:HD23	1:B:158:LEU:HD21	2.01	0.43
1:A:112:GLU:H	1:A:112:GLU:CD	2.27	0.43
1:A:20:LEU:C	1:A:20:LEU:HD23	2.44	0.42
1:B:19:MET:HE2	1:B:157:ASP:HB2	2.00	0.42
1:A:130:GLU:CD	1:A:175:LEU:HB2	2.45	0.42
1:B:130:GLU:CD	1:B:175:LEU:HB2	2.46	0.41
1:B:122:LEU:HD22	1:B:126:LEU:HG	2.03	0.41
1:A:111:TYR:CE1	1:A:115:LYS:HD2	2.56	0.41
1:A:83:GLN:NE2	1:B:75:THR:HG22	2.36	0.40
1:B:112:GLU:CD	1:B:112:GLU:H	2.29	0.40
1:A:182:ARG:NH2	3:A:228:HOH:O	2.44	0.40

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	206/210 (98%)	200 (97%)	5 (2%)	1 (0%)	24	16
1	B	206/210 (98%)	200 (97%)	5 (2%)	1 (0%)	24	16
All	All	412/420 (98%)	400 (97%)	10 (2%)	2 (0%)	24	16

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	64	GLN
1	B	64	GLN

5.3.2 Protein sidechains [i](#)

There are no protein residues with a non-rotameric sidechain to report in this entry.

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](#)

3 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	MES	A	211	-	12,12,12	3.38	7 (58%)	15,16,16	1.73	5 (33%)
2	MES	B	210	-	12,12,12	3.14	6 (50%)	15,16,16	1.74	5 (33%)
2	MES	A	210	-	12,12,12	3.17	7 (58%)	15,16,16	1.76	4 (26%)

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	MES	A	211	-	-	6/6/14/14	0/1/1/1
2	MES	B	210	-	-	3/6/14/14	0/1/1/1
2	MES	A	210	-	-	3/6/14/14	0/1/1/1

All (20) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	211	MES	O3S-S	5.57	1.68	1.47
2	B	210	MES	O3S-S	5.42	1.67	1.47
2	A	210	MES	O3S-S	5.08	1.66	1.47
2	A	211	MES	O2S-S	5.07	1.59	1.45
2	A	210	MES	O2S-S	4.81	1.58	1.45
2	A	211	MES	O1S-S	4.81	1.58	1.45
2	B	210	MES	O2S-S	4.67	1.58	1.45
2	B	210	MES	O1S-S	4.66	1.58	1.45
2	A	210	MES	O1S-S	4.50	1.57	1.45
2	A	211	MES	C7-N4	4.05	1.56	1.47
2	A	210	MES	C5-N4	3.89	1.57	1.46
2	A	211	MES	C3-N4	3.71	1.56	1.46
2	B	210	MES	C5-N4	3.69	1.56	1.46
2	A	210	MES	C3-N4	3.65	1.56	1.46
2	A	211	MES	C5-N4	3.64	1.56	1.46
2	B	210	MES	C3-N4	3.53	1.56	1.46
2	A	210	MES	C7-N4	3.40	1.55	1.47
2	B	210	MES	C7-N4	3.12	1.54	1.47
2	A	211	MES	C8-S	2.21	1.80	1.77
2	A	210	MES	C8-S	2.17	1.80	1.77

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	210	MES	O3S-S-C8	2.93	111.74	106.00
2	A	210	MES	O3S-S-C8	2.93	111.74	106.00
2	A	211	MES	O3S-S-C8	2.88	111.65	106.00
2	A	210	MES	O1S-S-C8	2.87	111.06	106.73
2	B	210	MES	O1S-S-C8	2.78	110.92	106.73
2	B	210	MES	C5-N4-C3	2.64	114.52	108.84
2	A	211	MES	O2S-S-C8	2.61	110.67	106.73
2	A	211	MES	C5-N4-C3	2.60	114.44	108.84
2	A	210	MES	C5-N4-C3	2.59	114.42	108.84
2	A	210	MES	O2S-S-C8	2.51	110.52	106.73

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	211	MES	O1S-S-C8	2.46	110.44	106.73
2	B	210	MES	O2S-S-C8	2.32	110.24	106.73
2	B	210	MES	O3S-S-O1S	-2.07	106.23	111.40
2	A	211	MES	C6-O1-C2	2.01	116.39	109.88

There are no chirality outliers.

All (12) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	210	MES	C7-C8-S-O2S
2	A	210	MES	C7-C8-S-O3S
2	A	211	MES	C8-C7-N4-C3
2	A	211	MES	N4-C7-C8-S
2	A	211	MES	C7-C8-S-O2S
2	A	211	MES	C7-C8-S-O3S
2	B	210	MES	C7-C8-S-O2S
2	B	210	MES	C7-C8-S-O3S
2	A	211	MES	C8-C7-N4-C5
2	A	210	MES	C7-C8-S-O1S
2	A	211	MES	C7-C8-S-O1S
2	B	210	MES	C7-C8-S-O1S

There are no ring outliers.

3 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	211	MES	3	0
2	B	210	MES	1	0
2	A	210	MES	1	0

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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.