



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 19, 2016 – 11:07 PM GMT

PDB ID : 5FPM
Title : Structure of heat shock-related 70kDA protein 2 with small-molecule ligand 5-phenyl-1,3,4-oxadiazole-2-thiol (AT809) in an alternate binding site.
Authors : Jhoti, H.; Ludlow, R.F.; Patel, S.; Saini, H.K.; Tickle, I.J.; Verdonk, M.
Deposited on : 2015-12-02
Resolution : 1.96 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
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026982
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20026982

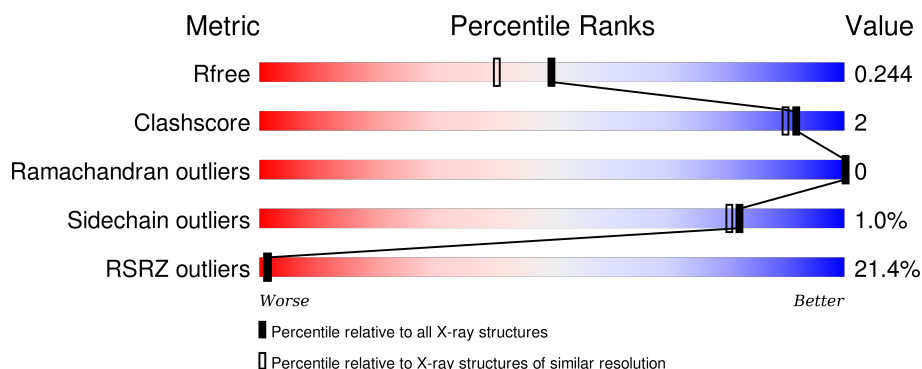
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.96 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}	91344	1833 (1.96-1.96)
Clashscore	102246	1953 (1.96-1.96)
Ramachandran outliers	100387	1936 (1.96-1.96)
Sidechain outliers	100360	1936 (1.96-1.96)
RSRZ outliers	91569	1835 (1.96-1.96)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	387	<div> <div>11%</div> <div> <div></div> <div>93%</div> <div>5% •</div> </div> </div>
1	B	387	<div> <div>31%</div> <div> <div></div> <div>92%</div> <div>6% •</div> </div> </div>

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	IWT	A	1385	-	-	-	X

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 6905 atoms, of which 12 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.

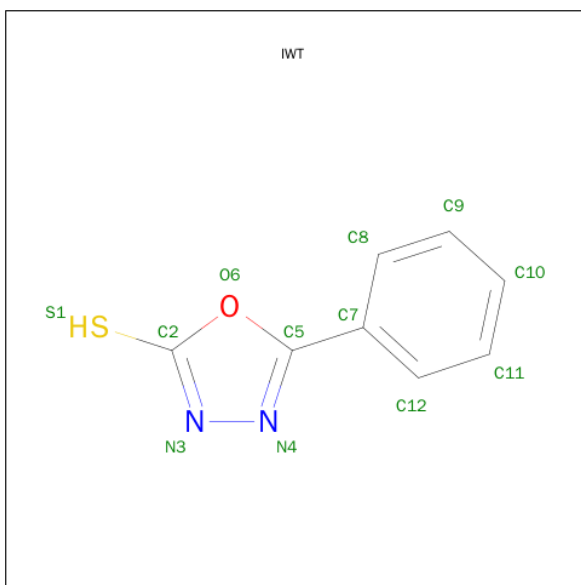
- Molecule 1 is a protein called HEAT SHOCK-RELATED 70KDA PROTEIN 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	381	Total	C	N	O	S	0	0	2
			2889	1822	501	559	7			
1	B	379	Total	C	N	O	S	0	0	0
			2887	1820	496	563	8			

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	GLY	-	EXPRESSION TAG	UNP P54652
A	-2	SER	-	EXPRESSION TAG	UNP P54652
A	-1	HIS	-	EXPRESSION TAG	UNP P54652
A	.	-	SER	DELETION	UNP P54652
A	.	-	ALA	DELETION	UNP P54652
B	-3	GLY	-	EXPRESSION TAG	UNP P54652
B	-2	SER	-	EXPRESSION TAG	UNP P54652
B	-1	HIS	-	EXPRESSION TAG	UNP P54652
B	.	-	SER	DELETION	UNP P54652
B	.	-	ALA	DELETION	UNP P54652

- Molecule 2 is 5-PHENYL-1,3,4-OXADIAZOLE-2-THIOL (three-letter code: IWT) (formula: C₈H₆N₂OS).



Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	A	1	Total	C	H	N	O	S	0	0
			18	8	6	2	1	1		
2	B	1	Total	C	H	N	O	S	0	0
			18	8	6	2	1	1		

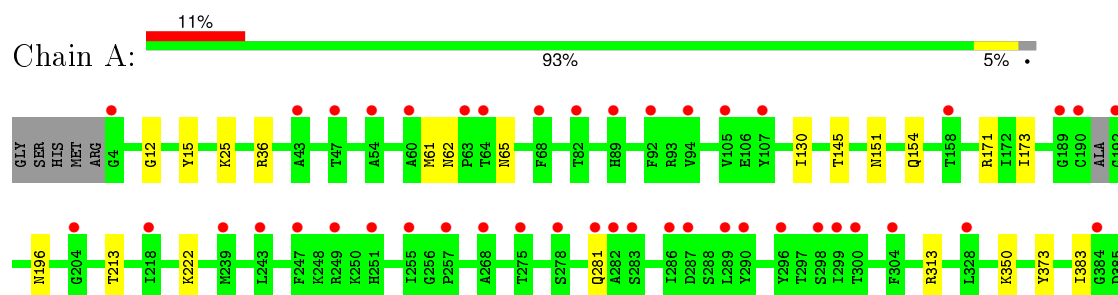
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	559	Total	O	0	0
			559	559		
3	B	534	Total	O	0	0
			534	534		

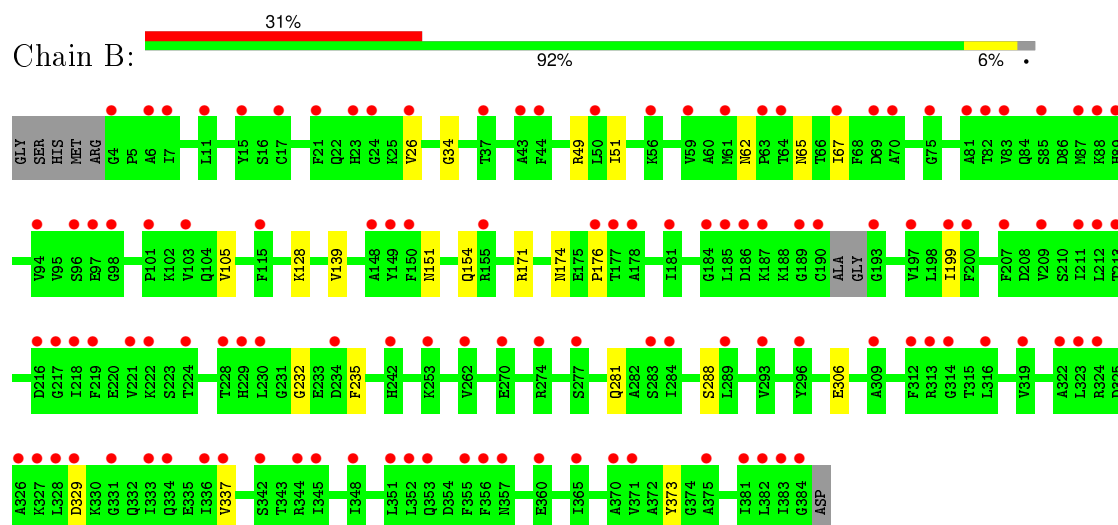
3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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: HEAT SHOCK-RELATED 70KDA PROTEIN 2



- Molecule 1: HEAT SHOCK-RELATED 70KDA PROTEIN 2



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	48.86Å 94.96Å 81.54Å 90.00° 89.98° 90.00°	Depositor
Resolution (Å)	38.37 – 1.96 38.34 – 1.95	Depositor EDS
% Data completeness (in resolution range)	97.6 (38.37-1.96) 96.2 (38.34-1.95)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.08 (at 1.95Å)	Xtriage
Refinement program	BUSTER 2.11.6	Depositor
R, R_{free}	0.170 , 0.218 0.234 , 0.244	Depositor DCC
R_{free} test set	2651 reflections (5.36%)	DCC
Wilson B-factor (Å ²)	21.1	Xtriage
Anisotropy	0.168	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 53.9	EDS
Estimated twinning fraction	0.360 for h,-k,-l	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.52$, $\langle L^2 \rangle = 0.36$	Xtriage
Outliers	1 of 52337 reflections (0.002%)	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	6905	wwPDB-VP
Average B, all atoms (Å ²)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.73% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: IWT

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	0.62	0/2934	0.62	0/3964
1	B	0.63	0/2932	0.62	0/3962
All	All	0.62	0/5866	0.62	0/7926

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

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	2889	0	2852	13	0
1	B	2887	0	2843	12	2
2	A	12	6	6	1	0
2	B	12	6	6	1	0
3	A	559	0	0	4	3
3	B	534	0	0	0	3
All	All	6893	12	5707	24	4

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 2.

All (24) 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:49:ARG:HD3	1:B:51:ILE:HD11	1.62	0.81
1:A:130:ILE:HG12	3:A:2084:HOH:O	1.93	0.68
1:B:151:ASN:H	1:B:154:GLN:HE21	1.41	0.67
1:A:151:ASN:H	1:A:154:GLN:HE21	1.42	0.65
1:B:62:ASN:HD21	1:B:65:ASN:HD22	1.54	0.55
1:A:151:ASN:H	1:A:154:GLN:NE2	2.07	0.53
1:A:350:LYS:HG2	3:A:2528:HOH:O	2.08	0.52
1:A:36:ARG:HG2	3:A:2073:HOH:O	2.08	0.52
1:B:232:GLY:HA2	1:B:235:PHE:CD2	2.48	0.49
1:B:199:ILE:HD13	1:B:337:VAL:HB	1.95	0.49
1:B:171:ARG:HA	2:B:1385:IWT:S1	2.54	0.47
1:B:174:ASN:HB3	1:B:176:PRO:HD2	1.97	0.47
1:A:61:MET:O	1:B:34:GLY:HA3	2.14	0.47
1:A:213:THR:HG23	1:A:222:LYS:HG3	1.99	0.45
1:A:12:GLY:HA3	1:A:15:TYR:O	2.17	0.45
1:A:62:ASN:HD21	1:A:65:ASN:HD22	1.64	0.44
1:A:25:LYS:HG3	3:A:2046:HOH:O	2.17	0.44
1:B:128:LYS:HE2	1:B:139:VAL:O	2.18	0.43
1:A:196:ASN:OD1	1:A:213:THR:HG22	2.18	0.43
1:B:26:VAL:HG11	1:B:373:TYR:HA	2.01	0.42
1:B:151:ASN:H	1:B:154:GLN:NE2	2.13	0.42
1:B:67:ILE:HD11	1:B:105:VAL:CG1	2.50	0.42
1:A:145:THR:HG22	1:A:173:ILE:HG13	2.01	0.41
1:A:171:ARG:HA	2:A:1385:IWT:S1	2.61	0.40

All (4) 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)
1:B:306:GLU:OE2	3:B:2270:HOH:O[2_746]	1.90	0.30
1:B:329:ASP:OD2	3:A:2464:HOH:O[2_646]	2.08	0.12
3:A:2304:HOH:O	3:B:2312:HOH:O[1_554]	2.09	0.11
3:A:2411:HOH:O	3:B:2511:HOH:O[2_656]	2.09	0.11

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	377/387 (97%)	369 (98%)	8 (2%)	0	100	100
1	B	375/387 (97%)	371 (99%)	4 (1%)	0	100	100
All	All	752/774 (97%)	740 (98%)	12 (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	296/316 (94%)	292 (99%)	4 (1%)	74	70
1	B	298/316 (94%)	296 (99%)	2 (1%)	88	88
All	All	594/632 (94%)	588 (99%)	6 (1%)	82	80

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	281	GLN
1	A	313	ARG
1	A	373	TYR
1	A	383	ILE
1	B	281	GLN
1	B	288	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	33	GLN
1	A	62	ASN
1	A	154	GLN
1	A	156	GLN
1	A	281	GLN
1	A	357	ASN
1	B	23	HIS
1	B	62	ASN
1	B	154	GLN
1	B	156	GLN
1	B	168	ASN
1	B	281	GLN
1	B	357	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

2 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	IWT	A	1385	-	7,13,13	0.36	0	9,17,17	1.20	1 (11%)
2	IWT	B	1385	-	7,13,13	0.28	0	9,17,17	1.09	1 (11%)

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	IWT	A	1385	-	-	0/2/4/4	0/1/2/2
2	IWT	B	1385	-	-	0/2/4/4	0/1/2/2

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	1385	IWT	C7-C5-N4	3.22	128.57	124.20
2	A	1385	IWT	C7-C5-N4	3.57	129.05	124.20

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1385	IWT	1	0
2	B	1385	IWT	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

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	381/387 (98%)	1.08	44 (11%) 6 11	13, 22, 39, 68	0
1	B	379/387 (97%)	1.78	119 (31%) 1 0	13, 22, 38, 82	0
All	All	760/774 (98%)	1.43	163 (21%) 1 1	13, 22, 39, 82	0

All (163) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	190	CYS	7.9
1	A	192	GLY	6.4
1	A	4	GLY	6.2
1	A	190	CYS	5.6
1	A	384	GLY	5.5
1	B	331	GLY	5.3
1	B	4	GLY	5.3
1	A	247	PHE	5.0
1	B	185	LEU	5.0
1	B	213	THR	4.7
1	B	384	GLY	4.7
1	B	148	ALA	4.4
1	B	230	LEU	4.3
1	B	356	PHE	4.3
1	B	381	ILE	4.3
1	B	21	PHE	4.3
1	B	189	GLY	4.1
1	B	218	ILE	4.1
1	B	15	TYR	4.1
1	B	319	VAL	4.1
1	B	228	THR	4.1
1	B	81	ALA	4.1
1	A	298	SER	4.0
1	B	211	ILE	4.0

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Mol	Chain	Res	Type	RSRZ
1	B	355	PHE	4.0
1	B	98	GLY	3.9
1	B	219	PHE	3.9
1	A	255	ILE	3.9
1	B	207	PHE	3.8
1	B	181	ILE	3.8
1	B	277	SER	3.8
1	B	322	ALA	3.8
1	A	251	HIS	3.7
1	B	82	THR	3.7
1	B	352	LEU	3.7
1	B	193	GLY	3.6
1	B	187	LYS	3.6
1	B	333	ILE	3.6
1	B	316	LEU	3.6
1	B	221	VAL	3.6
1	B	348	ILE	3.4
1	A	189	GLY	3.4
1	A	296	TYR	3.4
1	B	326	ALA	3.4
1	B	345	ILE	3.4
1	B	312	PHE	3.3
1	B	23	HIS	3.2
1	B	324	ARG	3.2
1	A	281	GLN	3.2
1	B	337	VAL	3.2
1	B	382	LEU	3.2
1	A	283	SER	3.2
1	B	323	LEU	3.1
1	A	300	THR	3.1
1	B	296	TYR	3.1
1	B	328	LEU	3.1
1	A	257	PRO	3.1
1	B	11	LEU	3.1
1	B	96	SER	3.1
1	B	177	THR	3.1
1	B	222	LYS	3.1
1	B	199	ILE	3.0
1	B	329	ASP	3.0
1	A	282	ALA	3.0
1	B	327	LYS	3.0
1	B	253	LYS	2.9

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Mol	Chain	Res	Type	RSRZ
1	B	370	ALA	2.9
1	B	67	ILE	2.9
1	B	186	ASP	2.9
1	B	59	VAL	2.9
1	B	371	VAL	2.8
1	B	309	ALA	2.8
1	B	216	ASP	2.8
1	B	37	THR	2.8
1	A	105	VAL	2.8
1	B	103	VAL	2.8
1	B	88	LYS	2.8
1	B	383	ILE	2.8
1	A	92	PHE	2.8
1	B	342	SER	2.7
1	B	314	GLY	2.7
1	B	83	VAL	2.7
1	B	101	PRO	2.7
1	B	200	PHE	2.7
1	A	243	LEU	2.7
1	B	89	HIS	2.7
1	A	89	HIS	2.7
1	B	344	ARG	2.7
1	A	278	SER	2.7
1	A	94	VAL	2.6
1	B	61	MET	2.6
1	B	313	ARG	2.6
1	B	217	GLY	2.6
1	B	293	VAL	2.6
1	B	155	ARG	2.5
1	B	351	LEU	2.5
1	B	375	ALA	2.5
1	B	176	PRO	2.5
1	B	357	ASN	2.5
1	B	85	SER	2.5
1	A	158	THR	2.5
1	B	7	ILE	2.5
1	A	239	MET	2.5
1	B	64	THR	2.5
1	B	353	GLN	2.4
1	B	212	LEU	2.4
1	A	204	GLY	2.4
1	A	275	THR	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	26	VAL	2.4
1	B	289	LEU	2.4
1	A	68	PHE	2.4
1	B	6	ALA	2.4
1	A	218	ILE	2.4
1	A	287	ASP	2.3
1	A	63	PRO	2.3
1	B	17	CYS	2.3
1	B	197	VAL	2.3
1	B	365	ILE	2.3
1	A	60	ALA	2.3
1	B	50	LEU	2.3
1	B	70	ALA	2.3
1	A	64	THR	2.3
1	B	115	PHE	2.3
1	B	150	PHE	2.3
1	B	209	VAL	2.3
1	B	336	ILE	2.3
1	B	75	GLY	2.3
1	B	274	ARG	2.3
1	A	54	ALA	2.3
1	B	283	SER	2.3
1	A	290	TYR	2.2
1	B	44	PHE	2.2
1	B	184	GLY	2.2
1	B	224	THR	2.2
1	A	286	ILE	2.2
1	A	82	THR	2.2
1	B	43	ALA	2.2
1	B	24	GLY	2.2
1	A	289	LEU	2.2
1	A	43	ALA	2.2
1	B	284	ILE	2.2
1	A	47	THR	2.2
1	B	229	HIS	2.2
1	A	304	PHE	2.2
1	B	234	ASP	2.2
1	B	334	GLN	2.2
1	A	249	ARG	2.1
1	A	328	LEU	2.1
1	B	63	PRO	2.1
1	B	97	GLU	2.1

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Mol	Chain	Res	Type	RSRZ
1	B	87	MET	2.1
1	A	107	TYR	2.1
1	B	56	LYS	2.1
1	B	149	TYR	2.1
1	B	242	HIS	2.1
1	B	69	ASP	2.1
1	A	268	ALA	2.1
1	B	178	ALA	2.1
1	B	262	VAL	2.0
1	A	299	ILE	2.0
1	B	360	GLU	2.0
1	B	94	VAL	2.0
1	B	270	GLU	2.0

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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å ²)	Q<0.9
2	IWT	A	1385	12/12	0.53	0.35	6.29	18,27,35,35	18
2	IWT	B	1385	12/12	0.71	0.26	1.49	11,20,27,27	18

6.5 Other polymers [i](#)

There are no such residues in this entry.