



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 02:31 PM UTC

PDB ID : 5K6H / pdb_00005k6h
Title : Crystal structure of prefusion-stabilized RSV F single-chain 9-10 DS-Cav1 A149C-Y458C variant.
Authors : Joyce, M.G.; Zhang, B.; Mascola, J.R.; Kwong, P.D.
Deposited on : 2016-05-24
Resolution : 2.65 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

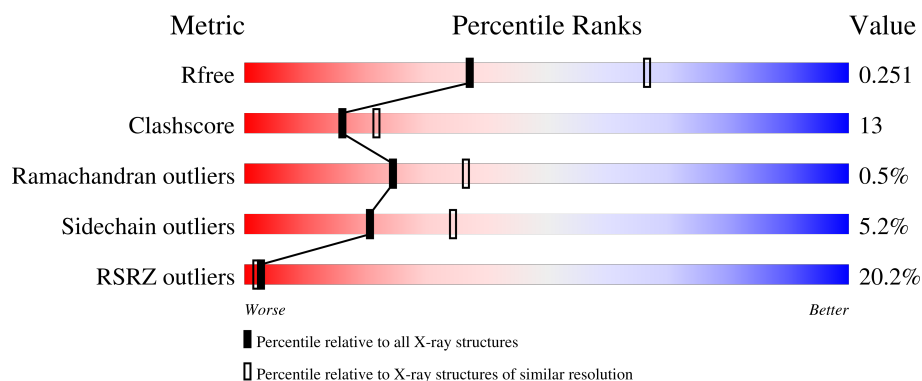
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.65 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}	180053	2053 (2.66-2.62)
Clashscore	190562	2097 (2.66-2.62)
Ramachandran outliers	187476	2066 (2.66-2.62)
Sidechain outliers	187428	2066 (2.66-2.62)
RSRZ outliers	180081	2052 (2.66-2.62)

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 $\leq 5\%$. 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	F	445	20% 79% 18% .

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 3492 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 Fusion glycoprotein F0.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	F	445	3445	2164	576	680	25	0	1	0

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
F	102	ALA	PRO	engineered mutation	UNP P03420
F	143	GLY	-	linker	UNP P03420
F	144	SER	-	linker	UNP P03420
F	149	CYS	ALA	engineered mutation	UNP P03420
F	155	CYS	SER	engineered mutation	UNP P03420
F	190	PHE	SER	engineered mutation	UNP P03420
F	207	LEU	VAL	engineered mutation	UNP P03420
F	290	CYS	SER	engineered mutation	UNP P03420
F	373	ARG	LEU	engineered mutation	UNP P03420
F	379	VAL	ILE	engineered mutation	UNP P03420
F	447	VAL	MET	engineered mutation	UNP P03420
F	458	CYS	TYR	engineered mutation	UNP P03420

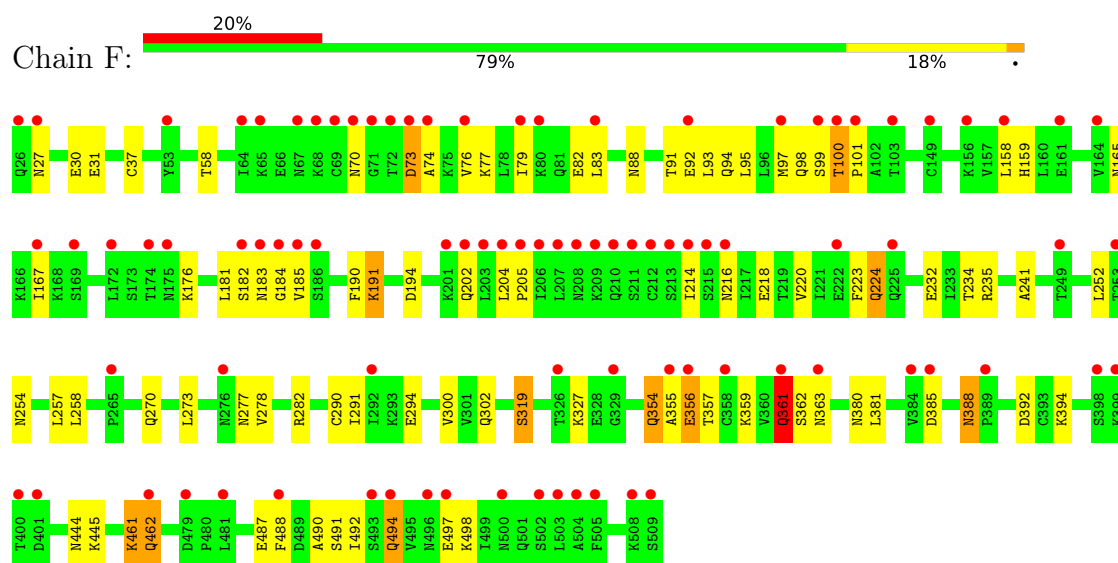
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	F	47	Total	O	0	0
			47	47		

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: Fusion glycoprotein F0



4 Data and refinement statistics

Property	Value	Source
Space group	P 41 3 2	Depositor
Cell constants a, b, c, α , β , γ	169.08Å 169.08Å 169.08Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.81 – 2.65 37.81 – 2.65	Depositor EDS
% Data completeness (in resolution range)	79.4 (37.81-2.65) 75.4 (37.81-2.65)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.83 (at 2.65Å)	Xtriage
Refinement program	PHENIX 1.10_2155	Depositor
R, R_{free}	0.222 , 0.252 0.226 , 0.251	Depositor DCC
R_{free} test set	966 reflections (3.92%)	wwPDB-VP
Wilson B-factor (Å ²)	49.5	Xtriage
Anisotropy	0.000	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 49.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	3492	wwPDB-VP
Average B, all atoms (Å ²)	70.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.00% 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](#)

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	F	0.37	0/3497	0.50	4/4737 (0.1%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	F	0	1

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
1	F	73	ASP	CA-C-N	-7.38	110.27	120.38
1	F	73	ASP	C-N-CA	-7.38	110.27	120.38
1	F	497	GLU	N-CA-C	-6.83	103.83	111.28
1	F	492	ILE	N-CA-C	-5.13	105.39	110.62

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	F	361	GLN	Peptide

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	F	3445	0	3487	91	0
2	F	47	0	0	5	0
All	All	3492	0	3487	91	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 13.

All (91) 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:F:392:ASP:OD1	1:F:491:SER:HB2	1.54	1.07
1:F:183:ASN:CB	1:F:185:VAL:HG23	1.84	1.06
1:F:99:SER:C	1:F:101:PRO:HD3	1.83	1.04
1:F:183:ASN:HB2	1:F:185:VAL:HG23	1.45	0.98
1:F:94:GLN:O	1:F:97:MET:HG2	1.68	0.93
1:F:99:SER:O	1:F:101:PRO:HD3	1.68	0.92
1:F:73:ASP:OD2	1:F:214:ILE:HG23	1.75	0.85
1:F:183:ASN:N	1:F:184:GLY:HA2	1.92	0.84
1:F:181:LEU:O	1:F:182:SER:OG	1.96	0.83
1:F:183:ASN:HB2	1:F:185:VAL:N	1.96	0.81
1:F:181:LEU:HD13	1:F:185:VAL:O	1.80	0.80
1:F:91:THR:O	1:F:95:LEU:HD13	1.81	0.80
1:F:277:ASN:OD1	1:F:361:GLN:HG2	1.83	0.78
1:F:99:SER:O	1:F:101:PRO:CD	2.31	0.78
1:F:73:ASP:HB3	1:F:76:VAL:HG23	1.65	0.78
1:F:82:GLU:HB3	1:F:223:PHE:HE2	1.50	0.75
1:F:181:LEU:HD12	1:F:181:LEU:N	2.03	0.73
1:F:82:GLU:HB3	1:F:223:PHE:CE2	2.23	0.73
1:F:183:ASN:HD22	1:F:185:VAL:HG21	1.58	0.68
1:F:73:ASP:O	1:F:74:ALA:C	2.32	0.67
1:F:491:SER:OG	1:F:494:GLN:HB3	1.95	0.67
1:F:79:ILE:HG22	1:F:83:LEU:CD1	2.26	0.66
1:F:183:ASN:HD22	1:F:185:VAL:CG2	2.08	0.66
1:F:183:ASN:HB2	1:F:185:VAL:H	1.59	0.66
1:F:158:LEU:HD21	1:F:167:ILE:HD11	1.77	0.66
1:F:79:ILE:HG22	1:F:83:LEU:HG	1.78	0.65
1:F:361:GLN:HE21	1:F:361:GLN:HA	1.64	0.63
1:F:392:ASP:CG	1:F:491:SER:HB2	2.24	0.62
1:F:37:CYS:SG	1:F:319:SER:HB3	2.39	0.62
1:F:79:ILE:HG22	1:F:83:LEU:HD11	1.82	0.62
1:F:362:SER:O	1:F:363:ASN:HB3	1.99	0.62
1:F:73:ASP:OD2	1:F:214:ILE:CG2	2.45	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:F:101:PRO:HB2	1:F:241:ALA:HB1	1.81	0.61
1:F:235:ARG:NH1	2:F:603:HOH:O	2.33	0.60
1:F:183:ASN:HB3	1:F:185:VAL:HG23	1.78	0.60
1:F:355:ALA:O	1:F:356:GLU:HB2	2.00	0.60
1:F:79:ILE:HG22	1:F:83:LEU:CG	2.32	0.59
1:F:100:THR:HG22	1:F:100:THR:O	2.02	0.59
1:F:159:HIS:CE1	1:F:291:ILE:CG2	2.86	0.58
1:F:392:ASP:OD1	1:F:491:SER:CB	2.42	0.58
1:F:158:LEU:CD2	1:F:167:ILE:HD11	2.33	0.58
1:F:181:LEU:C	1:F:182:SER:HG	2.01	0.57
1:F:183:ASN:ND2	1:F:185:VAL:CG2	2.68	0.56
1:F:361:GLN:O	1:F:362:SER:C	2.48	0.55
1:F:99:SER:C	1:F:101:PRO:CD	2.69	0.55
1:F:159:HIS:CE1	1:F:291:ILE:HG22	2.42	0.55
1:F:273:LEU:O	1:F:277:ASN:ND2	2.38	0.55
1:F:101:PRO:CB	1:F:241:ALA:HB1	2.38	0.54
1:F:392:ASP:CG	1:F:491:SER:CB	2.82	0.53
1:F:191:LYS:HE3	1:F:194:ASP:OD2	2.10	0.52
1:F:158:LEU:CD2	1:F:167:ILE:CD1	2.89	0.51
1:F:97:MET:HG3	1:F:98:GLN:N	2.25	0.51
1:F:183:ASN:CG	1:F:185:VAL:HG23	2.34	0.51
1:F:494:GLN:O	1:F:498:LYS:HB2	2.11	0.51
1:F:181:LEU:N	1:F:181:LEU:CD1	2.73	0.50
1:F:82:GLU:CD	1:F:224:GLN:HG3	2.37	0.50
1:F:258:LEU:HD21	1:F:278:VAL:HG21	1.94	0.50
1:F:270:GLN:NE2	2:F:609:HOH:O	2.46	0.48
1:F:354:GLN:HB2	2:F:628:HOH:O	2.14	0.48
1:F:91:THR:O	1:F:95:LEU:CD1	2.57	0.47
1:F:79:ILE:HD11	1:F:220:VAL:HG22	1.96	0.47
1:F:183:ASN:ND2	1:F:185:VAL:HG23	2.29	0.47
1:F:257:LEU:HD23	1:F:278:VAL:HG13	1.97	0.47
1:F:158:LEU:HD22	1:F:167:ILE:HD12	1.98	0.46
1:F:490:ALA:HB1	1:F:494:GLN:HG3	1.97	0.45
1:F:74:ALA:O	1:F:77:LYS:N	2.49	0.45
1:F:204:LEU:N	1:F:205:PRO:HD2	2.32	0.44
1:F:290:CYS:SG	1:F:300:VAL:HG23	2.57	0.44
1:F:93:LEU:HD11	1:F:234:THR:HG22	2.01	0.43
1:F:490:ALA:HB1	1:F:494:GLN:CG	2.48	0.43
1:F:27:ASN:N	2:F:606:HOH:O	2.52	0.43
1:F:462:GLN:NE2	2:F:610:HOH:O	2.51	0.42
1:F:216:ASN:ND2	1:F:218:GLU:OE1	2.45	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:F:354:GLN:HB3	1:F:357:THR:HG23	2.02	0.42
1:F:158:LEU:HD22	1:F:167:ILE:CD1	2.49	0.42
1:F:252:LEU:O	1:F:282:ARG:NH1	2.39	0.42
1:F:79:ILE:O	1:F:83:LEU:HG	2.20	0.41
1:F:258:LEU:HD21	1:F:278:VAL:CG2	2.51	0.41
1:F:388:ASN:C	1:F:388:ASN:HD22	2.27	0.41
1:F:444:ASN:O	1:F:461:LYS:NZ	2.54	0.41
1:F:381:LEU:HB3	1:F:388:ASN:OD1	2.20	0.41
1:F:99:SER:O	1:F:101:PRO:HD2	2.15	0.41
1:F:100:THR:N	1:F:101:PRO:HD3	2.28	0.41
1:F:165:ASN:ND2	1:F:294:GLU:OE1	2.53	0.41
1:F:385:ASP:O	1:F:388:ASN:OD1	2.38	0.41
1:F:88:ASN:O	1:F:92:GLU:HG3	2.20	0.41
1:F:94:GLN:O	1:F:97:MET:CG	2.54	0.40
1:F:232:GLU:OE1	1:F:235:ARG:NH2	2.55	0.40
1:F:327:LYS:H	1:F:327:LYS:HD2	1.86	0.40
1:F:58:THR:N	1:F:190:PHE:O	2.51	0.40
1:F:487:GLU:OE1	1:F:494:GLN:NE2	2.53	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	F	444/445 (100%)	428 (96%)	14 (3%)	2 (0%)	24	36

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	F	70	ASN
1	F	100	THR

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	F	408/407 (100%)	387 (95%)	21 (5%)	21	35

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	30	GLU
1	F	31	GLU
1	F	176	LYS
1	F	191	LYS
1	F	202	GLN
1	F	224	GLN
1	F	254	ASN
1	F	302	GLN
1	F	319	SER
1	F	354	GLN
1	F	356	GLU
1	F	359	LYS
1	F	361	GLN
1	F	380	ASN
1	F	388	ASN
1	F	394	LYS
1	F	445	LYS
1	F	461	LYS
1	F	462	GLN
1	F	488	PHE
1	F	494	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	F	183	ASN
1	F	270	GLN
1	F	317	HIS
1	F	361	GLN

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Mol	Chain	Res	Type
1	F	371	ASN
1	F	380	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](#)

There are no ligands in this entry.

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	F	445/445 (100%)	0.96	90 (20%) 3 2	25, 58, 144, 264	1 (0%)

All (90) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	97	MET	8.2
1	F	215	SER	6.5
1	F	214	ILE	6.5
1	F	213	SER	4.9
1	F	493	SER	4.8
1	F	401	ASP	4.7
1	F	204	LEU	4.6
1	F	502	SER	4.6
1	F	26	GLN	4.2
1	F	64	ILE	4.2
1	F	74	ALA	4.1
1	F	83	LEU	4.1
1	F	164	VAL	4.0
1	F	175	ASN	4.0
1	F	205	PRO	3.9
1	F	68	LYS	3.8
1	F	216	ASN	3.7
1	F	65	LYS	3.6
1	F	92	GLU	3.5
1	F	73	ASP	3.5
1	F	497	GLU	3.4
1	F	509	SER	3.3
1	F	363	ASN	3.3
1	F	488	PHE	3.3
1	F	212	CYS	3.3
1	F	203	LEU	3.2
1	F	185	VAL	3.2

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Mol	Chain	Res	Type	RSRZ
1	F	505	PHE	3.1
1	F	326	THR	3.1
1	F	149	CYS	3.1
1	F	222	GLU	3.1
1	F	210	GLN	3.1
1	F	70	ASN	3.0
1	F	206	ILE	3.0
1	F	207	LEU	3.0
1	F	356	GLU	3.0
1	F	508	LYS	2.9
1	F	479	ASP	2.9
1	F	504	ALA	2.9
1	F	481	LEU	2.9
1	F	462	GLN	2.9
1	F	211	SER	2.8
1	F	389	PRO	2.8
1	F	167	ILE	2.8
1	F	69	CYS	2.8
1	F	182	SER	2.8
1	F	103	THR	2.7
1	F	99	SER	2.7
1	F	169	SER	2.7
1	F	79	ILE	2.6
1	F	158	LEU	2.6
1	F	276	ASN	2.6
1	F	494	GLN	2.6
1	F	503	LEU	2.6
1	F	161	GLU	2.6
1	F	172	LEU	2.6
1	F	500	ASN	2.6
1	F	71	GLY	2.5
1	F	72	THR	2.5
1	F	400	THR	2.5
1	F	202	GLN	2.5
1	F	355	ALA	2.5
1	F	384	VAL	2.5
1	F	209	LYS	2.5
1	F	53	TYR	2.4
1	F	156	LYS	2.4
1	F	225	GLN	2.4
1	F	496	ASN	2.4
1	F	329	GLY	2.4

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Mol	Chain	Res	Type	RSRZ
1	F	398	SER	2.4
1	F	249	THR	2.3
1	F	385	ASP	2.3
1	F	27	ASN	2.3
1	F	361	GLN	2.3
1	F	358	CYS	2.2
1	F	184	GLY	2.2
1	F	201	LYS	2.2
1	F	399	LYS	2.2
1	F	174	THR	2.2
1	F	67	ASN	2.1
1	F	208	ASN	2.1
1	F	101	PRO	2.1
1	F	186	SER	2.1
1	F	253	THR	2.1
1	F	183	ASN	2.1
1	F	265	PRO	2.0
1	F	292	ILE	2.0
1	F	76	VAL	2.0
1	F	80	LYS	2.0
1	F	100	THR	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 oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.