



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 10:52 PM UTC

PDB ID : 3DO4 / pdb\_00003do4  
Title : Crystal structure of transthyretin variant T60A at acidic pH  
Authors : Cendron, L.; Zanotti, G.; Folli, C.; Berni, R.  
Deposited on : 2008-07-03  
Resolution : 2.40 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto: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>.

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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) : 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

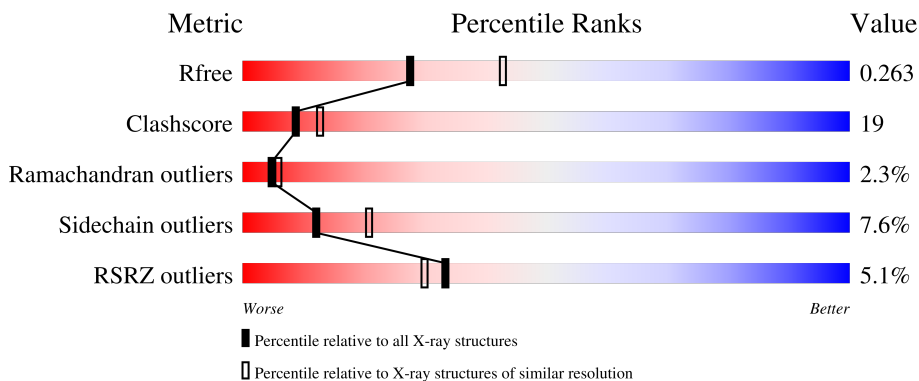
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.40 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	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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  $\geq 3$ , 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	A	127	 3% 63% 23% 6% 9%
1	B	127	 4% 61% 23% 6% 9%
1	C	127	 5% 54% 32% 5% 9%
1	D	127	 4% 56% 31% 5% 9%
1	E	127	 5% 41% 42% 9% 9%

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Mol	Chain	Length	Quality of chain
1	F	127	
1	G	127	
1	H	127	

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	ACT	A	128	-	-	X	-
2	ACT	B	128	-	-	X	-

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 7303 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 Transthyretin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	116	894	572	147	173	2	0	0	0
1	B	116	894	572	147	173	2	0	0	0
1	C	116	894	572	147	173	2	0	0	0
1	D	116	894	572	147	173	2	0	0	0
1	E	116	894	572	147	173	2	0	0	0
1	F	116	894	572	147	173	2	0	0	0
1	G	116	894	572	147	173	2	0	0	0
1	H	116	894	572	147	173	2	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	60	ALA	THR	engineered mutation	UNP P02766
B	60	ALA	THR	engineered mutation	UNP P02766
C	60	ALA	THR	engineered mutation	UNP P02766
D	60	ALA	THR	engineered mutation	UNP P02766
E	60	ALA	THR	engineered mutation	UNP P02766
F	60	ALA	THR	engineered mutation	UNP P02766
G	60	ALA	THR	engineered mutation	UNP P02766
H	60	ALA	THR	engineered mutation	UNP P02766

- Molecule 2 is ACETATE ION (CCD ID: ACT) (formula: C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 4 2 2	0	0
2	A	1	Total C O 4 2 2	0	0
2	B	1	Total C O 4 2 2	0	0
2	G	1	Total C O 4 2 2	0	0
2	H	1	Total C O 4 2 2	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	28	Total O 28 28	0	0
3	B	26	Total O 26 26	0	0
3	C	17	Total O 17 17	0	0
3	D	13	Total O 13 13	0	0
3	E	14	Total O 14 14	0	0
3	F	13	Total O 13 13	0	0
3	G	12	Total O 12 12	0	0

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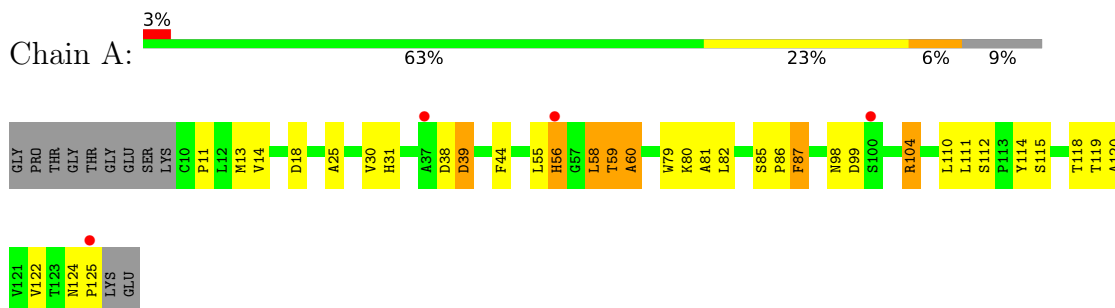
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<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
3	H	8	Total	O	0	0
			8	8		

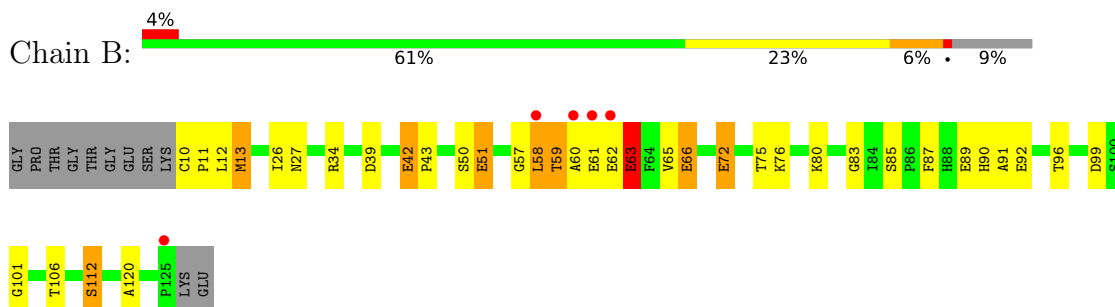
### 3 Residue-property plots [i](#)

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: Transthyretin



- Molecule 1: Transthyretin

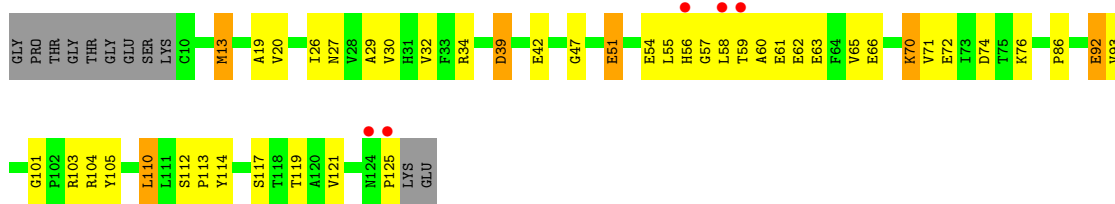


- Molecule 1: Transthyretin

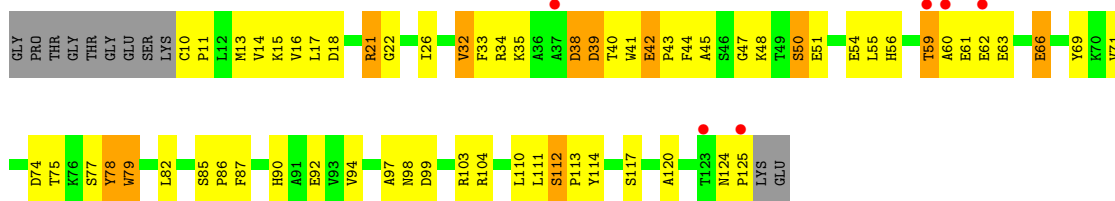


- Molecule 1: Transthyretin

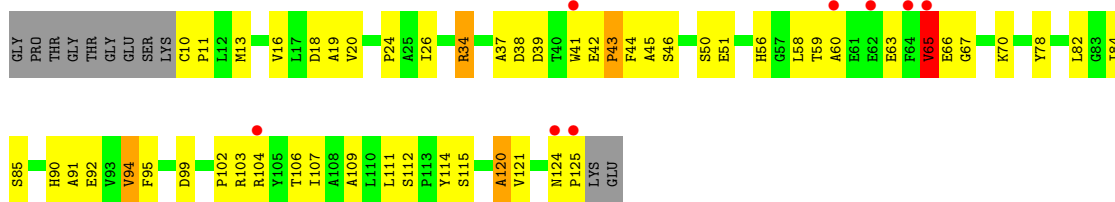




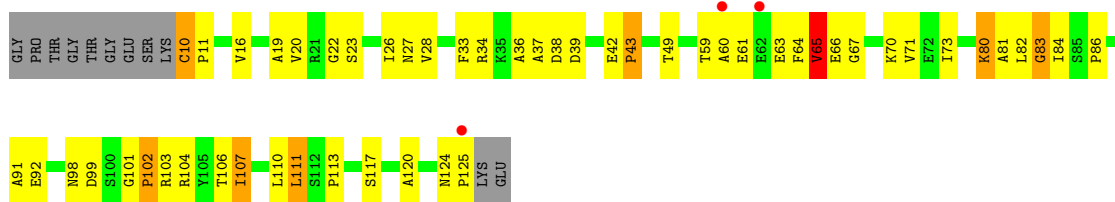
• Molecule 1: Transthyretin



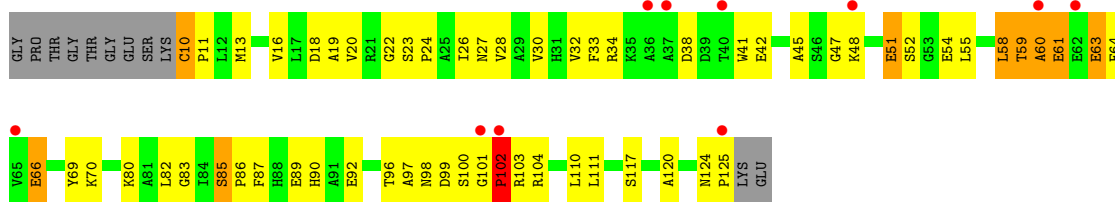
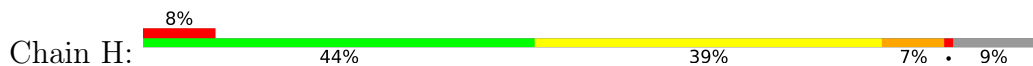
• Molecule 1: Transthyretin



• Molecule 1: Transthyretin



• Molecule 1: Transthyretin



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	60.59Å 75.91Å 107.27Å 90.00° 93.10° 90.00°	Depositor
Resolution (Å)	107.20 – 2.40 107.11 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.5 (107.20-2.40) 99.5 (107.11-2.40)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.67 (at 2.40Å)	Xtrriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.202 , 0.267 0.201 , 0.263	Depositor DCC
$R_{free}$ test set	1900 reflections (4.97%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	46.0	Xtrriage
Anisotropy	0.431	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 49.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	7303	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	50.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.94% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: ACT

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	1.74	11/918 (1.2%)	1.43	7/1253 (0.6%)
1	B	1.55	4/918 (0.4%)	1.37	11/1253 (0.9%)
1	C	1.71	15/918 (1.6%)	1.40	9/1253 (0.7%)
1	D	1.60	8/918 (0.9%)	1.38	8/1253 (0.6%)
1	E	1.68	12/918 (1.3%)	1.47	9/1253 (0.7%)
1	F	1.61	12/918 (1.3%)	1.35	4/1253 (0.3%)
1	G	1.36	4/918 (0.4%)	1.39	7/1253 (0.6%)
1	H	1.37	1/918 (0.1%)	1.44	8/1253 (0.6%)
All	All	1.58	67/7344 (0.9%)	1.40	63/10024 (0.6%)

The worst 5 of 67 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	71	VAL	CA-CB	-9.43	1.43	1.54
1	C	96	THR	CA-CB	9.20	1.65	1.53
1	C	19	ALA	CA-CB	8.87	1.68	1.53
1	C	71	VAL	CA-C	-8.86	1.41	1.52
1	F	91	ALA	CA-CB	-8.00	1.40	1.53

The worst 5 of 63 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	H	85	SER	CA-C-N	13.19	132.88	120.21
1	H	85	SER	C-N-CA	13.19	132.88	120.21
1	G	101	GLY	CA-C-N	8.77	130.80	119.84
1	G	101	GLY	C-N-CA	8.77	130.80	119.84
1	E	82	LEU	N-CA-C	-7.86	101.91	114.09

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	894	0	867	30	0
1	B	894	0	867	30	0
1	C	894	0	867	22	0
1	D	894	0	867	27	0
1	E	894	0	867	40	0
1	F	894	0	867	32	0
1	G	894	0	867	47	0
1	H	894	0	867	52	0
2	A	8	0	6	4	0
2	B	4	0	3	2	0
2	G	4	0	3	0	0
2	H	4	0	3	0	0
3	A	28	0	0	1	0
3	B	26	0	0	5	0
3	C	17	0	0	0	0
3	D	13	0	0	0	0
3	E	14	0	0	3	0
3	F	13	0	0	0	0
3	G	12	0	0	0	0
3	H	8	0	0	1	0
All	All	7303	0	6951	264	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 19.

The worst 5 of 264 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:104:ARG:NH1	1:A:125:PRO:HA	1.67	1.08
1:A:104:ARG:HH12	1:A:125:PRO:HA	1.07	1.07
1:E:11:PRO:HD2	1:E:59:THR:CG2	1.84	1.07
1:A:59:THR:HG22	1:A:60:ALA:O	1.57	1.04
1:E:11:PRO:HD2	1:E:59:THR:HG21	1.03	1.02

There are no symmetry-related clashes.

## 5.3 Torsion angles [i](#)

### 5.3.1 Protein backbone [i](#)

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	114/127 (90%)	106 (93%)	7 (6%)	1 (1%)	14	22
1	B	114/127 (90%)	107 (94%)	5 (4%)	2 (2%)	6	9
1	C	114/127 (90%)	104 (91%)	5 (4%)	5 (4%)	2	1
1	D	114/127 (90%)	106 (93%)	7 (6%)	1 (1%)	14	22
1	E	114/127 (90%)	101 (89%)	11 (10%)	2 (2%)	6	9
1	F	114/127 (90%)	99 (87%)	13 (11%)	2 (2%)	6	9
1	G	114/127 (90%)	98 (86%)	11 (10%)	5 (4%)	2	1
1	H	114/127 (90%)	101 (89%)	10 (9%)	3 (3%)	4	4
All	All	912/1016 (90%)	822 (90%)	69 (8%)	21 (2%)	5	6

5 of 21 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	59	THR
1	B	63	GLU
1	C	61	GLU
1	E	50	SER
1	G	102	PRO

### 5.3.2 Protein sidechains [i](#)

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	96/104 (92%)	93 (97%)	3 (3%)	35	57

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	B	96/104 (92%)	86 (90%)	10 (10%)	7	10
1	C	96/104 (92%)	90 (94%)	6 (6%)	16	29
1	D	96/104 (92%)	89 (93%)	7 (7%)	13	22
1	E	96/104 (92%)	86 (90%)	10 (10%)	7	10
1	F	96/104 (92%)	90 (94%)	6 (6%)	16	29
1	G	96/104 (92%)	90 (94%)	6 (6%)	16	29
1	H	96/104 (92%)	86 (90%)	10 (10%)	7	10
All	All	768/832 (92%)	710 (92%)	58 (8%)	12	21

5 of 58 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	39	ASP
1	H	66	GLU
1	E	113	PRO
1	H	63	GLU
1	H	42	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	90	HIS
1	G	124	ASN
1	H	124	ASN
1	H	56	HIS
1	C	27	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](#)

5 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	ACT	B	128	-	3,3,3	1.26	0	3,3,3	1.13	0
2	ACT	H	128	-	3,3,3	1.65	1 (33%)	3,3,3	0.08	0
2	ACT	G	128	-	3,3,3	1.46	1 (33%)	3,3,3	0.68	0
2	ACT	A	129	-	3,3,3	1.31	0	3,3,3	0.59	0
2	ACT	A	128	-	3,3,3	1.20	1 (33%)	3,3,3	1.28	0

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	G	128	ACT	CH3-C	2.14	1.57	1.49
2	H	128	ACT	CH3-C	2.12	1.57	1.49
2	A	128	ACT	O-C	2.04	1.31	1.22

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	128	ACT	2	0
2	A	128	ACT	4	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 [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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	116/127 (91%)	0.01	4 (3%) 48 44	18, 39, 70, 84	2 (1%)
1	B	116/127 (91%)	0.12	5 (4%) 40 36	24, 42, 78, 87	3 (2%)
1	C	116/127 (91%)	0.13	6 (5%) 33 29	23, 43, 80, 90	3 (2%)
1	D	116/127 (91%)	0.24	5 (4%) 40 36	27, 45, 80, 90	1 (0%)
1	E	116/127 (91%)	0.41	6 (5%) 33 29	22, 48, 87, 109	3 (2%)
1	F	116/127 (91%)	0.27	8 (6%) 23 19	22, 49, 87, 109	2 (1%)
1	G	116/127 (91%)	0.24	3 (2%) 57 53	28, 50, 83, 102	3 (2%)
1	H	116/127 (91%)	0.50	10 (8%) 16 13	25, 51, 86, 105	3 (2%)
All	All	928/1016 (91%)	0.24	47 (5%) 33 30	18, 46, 84, 109	20 (2%)

The worst 5 of 47 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	62	GLU	4.6
1	H	62	GLU	3.8
1	C	59	THR	3.6
1	D	58	LEU	3.5
1	F	125	PRO	3.4

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
2	ACT	H	128	4/4	0.62	0.23	60,60,61,61	0
2	ACT	G	128	4/4	0.70	0.22	64,64,65,65	0
2	ACT	B	128	4/4	0.90	0.13	41,43,44,48	0
2	ACT	A	129	4/4	0.93	0.12	46,47,49,51	0
2	ACT	A	128	4/4	0.97	0.08	31,32,33,33	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.