



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 02:42 AM GMT

PDB ID : 2I9E  
Title : Structure of Triosephosphate Isomerase of Tenebrio molitor  
Authors : Schmidt, A.; Scheerer, P.; Wessner, H.; Hoehne, W.; Krauss, N.  
Deposited on : 2006-09-05  
Resolution : 2.00 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  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
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) : trunk26865

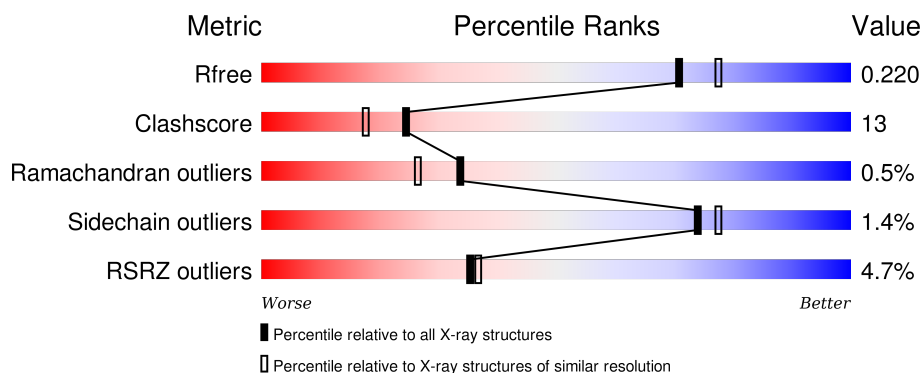
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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	6249 (2.00-2.00)
Clashscore	102246	7340 (2.00-2.00)
Ramachandran outliers	100387	7248 (2.00-2.00)
Sidechain outliers	100360	7247 (2.00-2.00)
RSRZ outliers	91569	6262 (2.00-2.00)

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  $\geq 3$ , 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	259	
1	B	259	
1	C	259	
1	D	259	

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	TRS	B	1002	-	-	-	X
2	TRS	B	1004	-	-	X	X
2	TRS	C	1001	-	-	-	X
2	TRS	D	1003	-	-	X	X
2	TRS	D	1005	-	-	-	X

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 7898 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 Triosephosphate isomerase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	246	Total	C	N	O	S	0	0	0
			1869	1182	325	354	8			
1	B	248	Total	C	N	O	S	0	0	0
			1884	1193	327	356	8			
1	C	246	Total	C	N	O	S	0	0	0
			1869	1182	325	354	8			
1	D	248	Total	C	N	O	S	0	0	0
			1884	1193	327	356	8			

There are 60 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	241	ASP	ASN	ENGINEERED	UNP Q8MPF2
A	243	ILE	VAL	ENGINEERED	UNP Q8MPF2
A	246	ARG	LYS	ENGINEERED	UNP Q8MPF2
A	248	LEU	-	CLONING ARTIFACT	UNP Q8MPF2
A	249	VAL	-	CLONING ARTIFACT	UNP Q8MPF2
A	250	PRO	-	CLONING ARTIFACT	UNP Q8MPF2
A	251	ARG	-	CLONING ARTIFACT	UNP Q8MPF2
A	252	GLY	-	CLONING ARTIFACT	UNP Q8MPF2
A	253	SER	-	CLONING ARTIFACT	UNP Q8MPF2
A	254	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
A	255	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
A	256	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
A	257	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
A	258	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
A	259	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
B	241	ASP	ASN	ENGINEERED	UNP Q8MPF2
B	243	ILE	VAL	ENGINEERED	UNP Q8MPF2
B	246	ARG	LYS	ENGINEERED	UNP Q8MPF2
B	248	LEU	-	CLONING ARTIFACT	UNP Q8MPF2
B	249	VAL	-	CLONING ARTIFACT	UNP Q8MPF2
B	250	PRO	-	CLONING ARTIFACT	UNP Q8MPF2

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Chain	Residue	Modelled	Actual	Comment	Reference
B	251	ARG	-	CLONING ARTIFACT	UNP Q8MPF2
B	252	GLY	-	CLONING ARTIFACT	UNP Q8MPF2
B	253	SER	-	CLONING ARTIFACT	UNP Q8MPF2
B	254	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
B	255	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
B	256	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
B	257	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
B	258	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
B	259	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
C	241	ASP	ASN	ENGINEERED	UNP Q8MPF2
C	243	ILE	VAL	ENGINEERED	UNP Q8MPF2
C	246	ARG	LYS	ENGINEERED	UNP Q8MPF2
C	248	LEU	-	CLONING ARTIFACT	UNP Q8MPF2
C	249	VAL	-	CLONING ARTIFACT	UNP Q8MPF2
C	250	PRO	-	CLONING ARTIFACT	UNP Q8MPF2
C	251	ARG	-	CLONING ARTIFACT	UNP Q8MPF2
C	252	GLY	-	CLONING ARTIFACT	UNP Q8MPF2
C	253	SER	-	CLONING ARTIFACT	UNP Q8MPF2
C	254	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
C	255	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
C	256	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
C	257	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
C	258	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
C	259	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
D	241	ASP	ASN	ENGINEERED	UNP Q8MPF2
D	243	ILE	VAL	ENGINEERED	UNP Q8MPF2
D	246	ARG	LYS	ENGINEERED	UNP Q8MPF2
D	248	LEU	-	CLONING ARTIFACT	UNP Q8MPF2
D	249	VAL	-	CLONING ARTIFACT	UNP Q8MPF2
D	250	PRO	-	CLONING ARTIFACT	UNP Q8MPF2
D	251	ARG	-	CLONING ARTIFACT	UNP Q8MPF2
D	252	GLY	-	CLONING ARTIFACT	UNP Q8MPF2
D	253	SER	-	CLONING ARTIFACT	UNP Q8MPF2
D	254	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
D	255	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
D	256	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
D	257	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
D	258	HIS	-	CLONING ARTIFACT	UNP Q8MPF2
D	259	HIS	-	CLONING ARTIFACT	UNP Q8MPF2

- Molecule 2 is 2-AMINO-2-HYDROXYMETHYL-PROPANE-1,3-DIOL (three-letter code: TRS) (formula: C<sub>4</sub>H<sub>12</sub>NO<sub>3</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	C	1	Total	C	N	O	0	0
			8	4	1	3		
2	B	1	Total	C	N	O	0	0
			8	4	1	3		
2	D	1	Total	C	N	O	0	0
			8	4	1	3		
2	B	1	Total	C	N	O	0	0
			8	4	1	3		
2	D	1	Total	C	N	O	0	0
			8	4	1	3		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	93	Total	O	0	0
			93	93		
3	B	87	Total	O	0	0
			87	87		
3	C	95	Total	O	0	0
			95	95		
3	D	77	Total	O	0	0
			77	77		



- Molecule 1: Triosephosphate isomerase



I243	I244
Q247	LEU
VAL	PRO
ARG	GLY
SER	HIS
HIS	HIS
HIS	HIS
HIS	HIS

● Molecule 1: Triosephosphate isomerase



MET	A2	R3	V6	H11	I20	N21	I24	G30	P31	L32	N33	Q34	D35	V42	L47	E48	L49	V50	R51	T52	Q53	V54	I58	G59	V60	A61	A62	Q63	H64	A72	I77	K83	D88	H89	V90	I91	I92	G93	Q99	G102	E103	S104	L107	I108
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C113	E117	L120	R133	T138	E139	V142	F143	R144	V166	W167	A168	I169	G170	T171	G172	K173	T174	A175	T176	Q179	I191	I195	D196	A197	K198	V199	R204	N215	L219	Q222	P223	D226	G227	F228	L229	K236	P237	V240	Q247	L248	V249
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PRO	ARG	GLY	SER	HIS	HIS	HIS	HIS	HIS
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## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	37.06 Å 145.08 Å 94.28 Å 90.00° 95.61° 90.00°	Depositor
Resolution (Å)	29.33 – 2.00 29.33 – 2.00	Depositor EDS
% Data completeness (in resolution range)	80.4 (29.33-2.00) 80.4 (29.33-2.00)	Depositor EDS
$R_{merge}$	0.00	Depositor
$R_{sym}$	0.08	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.87 (at 2.00 Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.219 , 0.239 0.222 , 0.220	Depositor DCC
$R_{free}$ test set	2729 reflections (5.09%)	DCC
Wilson B-factor (Å <sup>2</sup> )	19.6	Xtriage
Anisotropy	1.032	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 43.5	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.29$	Xtriage
Outliers	1 of 53630 reflections (0.002%)	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	7898	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	29.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.55% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: TRS

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	0.31	0/1901	0.60	1/2575 (0.0%)
1	B	0.32	0/1916	0.59	1/2596 (0.0%)
1	C	0.32	0/1901	0.60	0/2575
1	D	0.32	0/1916	0.59	1/2596 (0.0%)
All	All	0.32	0/7634	0.59	3/10342 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	229	LEU	N-CA-C	-6.04	94.69	111.00
1	D	229	LEU	N-CA-C	-5.15	97.09	111.00
1	A	229	LEU	N-CA-C	-5.12	97.18	111.00

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	1869	0	1885	43	0
1	B	1884	0	1905	53	0
1	C	1869	0	1885	47	0
1	D	1884	0	1905	57	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	16	0	24	6	0
2	C	8	0	12	4	0
2	D	16	0	24	6	0
3	A	93	0	0	1	0
3	B	87	0	0	2	0
3	C	95	0	0	1	0
3	D	77	0	0	0	0
All	All	7898	0	7640	196	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.

The worst 5 of 196 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:99:GLN:HE22	1:B:166:VAL:HG11	1.17	1.04
1:B:232:GLY:HA2	2:B:1004:TRS:H22	1.51	0.93
1:D:99:GLN:HE22	1:D:166:VAL:HG11	1.34	0.91
1:B:131:GLU:HG2	3:B:1012:HOH:O	1.80	0.79
1:C:102:GLY:HA3	2:C:1001:TRS:H32	1.66	0.78

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	244/259 (94%)	236 (97%)	7 (3%)	1 (0%)	39	33
1	B	246/259 (95%)	236 (96%)	10 (4%)	0	100	100
1	C	244/259 (94%)	236 (97%)	6 (2%)	2 (1%)	24	15
1	D	246/259 (95%)	234 (95%)	10 (4%)	2 (1%)	24	15

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	980/1036 (95%)	942 (96%)	33 (3%)	5 (0%)	34 26

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	173	LYS
1	D	174	THR
1	A	30	GLY
1	C	29	SER
1	C	30	GLY

### 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	197/209 (94%)	194 (98%)	3 (2%)	72 75
1	B	199/209 (95%)	197 (99%)	2 (1%)	82 85
1	C	197/209 (94%)	194 (98%)	3 (2%)	72 75
1	D	199/209 (95%)	196 (98%)	3 (2%)	72 75
All	All	792/836 (95%)	781 (99%)	11 (1%)	74 77

5 of 11 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	47	LEU
1	C	6	VAL
1	D	21	ASN
1	B	21	ASN
1	C	219	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	99	GLN
1	C	21	ASN
1	D	99	GLN
1	B	14	ASN
1	C	201	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](#)

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	TRS	B	1002	-	7,7,7	1.19	1 (14%)	9,9,9	0.63	0
2	TRS	B	1004	-	7,7,7	1.17	1 (14%)	9,9,9	0.85	0
2	TRS	C	1001	-	7,7,7	1.01	1 (14%)	9,9,9	0.67	0
2	TRS	D	1003	-	7,7,7	1.26	1 (14%)	9,9,9	0.79	0
2	TRS	D	1005	-	7,7,7	1.10	1 (14%)	9,9,9	0.75	0

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	TRS	B	1002	-	-	0/9/9/9	0/0/0/0
2	TRS	B	1004	-	-	0/9/9/9	0/0/0/0
2	TRS	C	1001	-	-	0/9/9/9	0/0/0/0
2	TRS	D	1003	-	-	0/9/9/9	0/0/0/0
2	TRS	D	1005	-	-	0/9/9/9	0/0/0/0

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	1003	TRS	C-N	-2.96	1.46	1.50
2	B	1002	TRS	C-N	-2.53	1.47	1.50
2	C	1001	TRS	C-N	-2.11	1.47	1.50
2	D	1005	TRS	C-N	-2.10	1.47	1.50
2	B	1004	TRS	C-N	-2.05	1.47	1.50

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	1004	TRS	6	0
2	C	1001	TRS	4	0
2	D	1003	TRS	6	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	246/259 (94%)	0.27	12 (4%) 33 35	16, 26, 46, 61	0
1	B	248/259 (95%)	0.25	9 (3%) 46 48	17, 26, 45, 58	0
1	C	246/259 (94%)	0.30	11 (4%) 37 38	17, 28, 47, 58	0
1	D	248/259 (95%)	0.36	14 (5%) 28 29	18, 27, 48, 71	0
All	All	988/1036 (95%)	0.29	46 (4%) 35 37	16, 27, 47, 71	0

The worst 5 of 46 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	2	ALA	6.7
1	D	171	THR	5.6
1	A	2	ALA	5.1
1	D	174	THR	4.9
1	B	249	VAL	4.2

### 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, 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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
2	TRS	D	1003	8/8	0.67	0.48	22.45	56,61,66,67	0
2	TRS	D	1005	8/8	0.06	0.66	17.03	68,79,84,84	0
2	TRS	C	1001	8/8	0.58	0.36	17.02	53,68,73,74	0
2	TRS	B	1002	8/8	0.57	0.37	13.13	48,54,59,60	0
2	TRS	B	1004	8/8	0.75	0.37	11.97	23,37,45,52	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.