WORLDWIDE PDB PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report (i)

May 15, 2020 – 08:09 pm BST

PDB ID	:	1NTM
Title	:	Crystal Structure of Mitochondrial Cytochrome bc1 Complex at 2.4 Angstrom
Authors	:	Gao, X.; Wen, X.; Esser, L.; Quinn, B.; Yu, L.; Yu, C.; Xia, D.
Deposited on	:	2003-01-30
Resolution	:	2.40 Å(reported)

The following versions of software and data (see references (1)) were used in the production of this report:

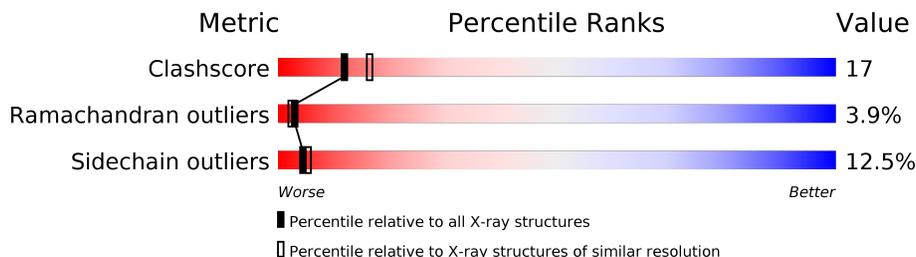|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
buster-report	:	1.1.7 (2018)
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

1 Overall quality at a glance (i)

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	Percentile Ranks	Value
Clashscore		17
Ramachandran outliers		3.9%
Sidechain outliers		12.5%

Worse   *Better*

∎ Percentile relative to all X-ray structures

⫾ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (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 on 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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	446	66% 27% 6% •
2	B	439	63% 28% • • •
3	C	379	64% 29% 6% •
4	D	241	41% 44% 14% •
5	E	196	70% 23% 5% •
6	F	110	63% 25% 8% 5%
7	G	81	64% 21% 6% • 7%
8	H	78	58% 21% 6% • 14%

Continued on next page...

Continued from previous page...

Mol	Chain	Length	Quality of chain
9	I	57	19% 42% 35% ·
10	J	62	56% 31% 10% ·
11	K	56	57% 23% 11% 9%

2 Entry composition (i)

There are 14 unique types of molecules in this entry. The entry contains 17049 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 Ubiquinol-cytochrome C reductase complex core protein I, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	446	3458	2161	609	668	20	0	0	0

- Molecule 2 is a protein called Ubiquinol-cytochrome C reductase complex core protein 2, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	423	3172	1993	562	610	7	0	0	0

- Molecule 3 is a protein called Cytochrome b.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	C	378	3003	2013	471	501	18	0	0	0

- Molecule 4 is a protein called cytochrome c1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	D	241	1918	1225	330	348	15	0	0	0

- Molecule 5 is a protein called UBIQUINOL-CYTOCHROME C REDUCTASE IRON-SULFUR SUBUNIT, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
5	E	196	1519	957	263	291	8	0	0	0

- Molecule 6 is a protein called Ubiquinol-cytochrome C reductase complex 14 kDa protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	F	105	Total 911	C 576	N 165	O 168	S 2	0	0	0

- Molecule 7 is a protein called Ubiquinol-cytochrome C reductase complex ubiquinone-binding protein QP-C.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	G	75	Total 628	C 410	N 118	O 99	S 1	0	0	0

- Molecule 8 is a protein called Ubiquinol-cytochrome C reductase complex 11 kDa protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
8	H	67	Total 548	C 332	N 99	O 112	S 5	0	0	0

- Molecule 9 is a protein called Ubiquinol-cytochrome C reductase 8 kDa protein.

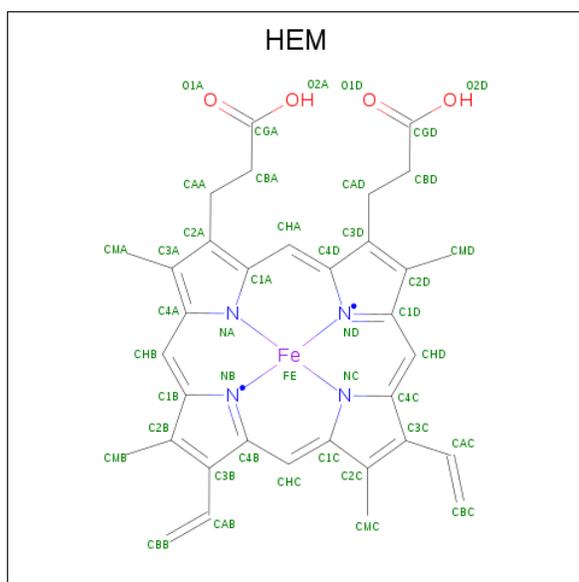| Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
9	I	57	Total 406	C 253	N 77	O 74	S 2	0	0	0

- Molecule 10 is a protein called Ubiquinol-cytochrome C reductase complex 7.2 kDa protein.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
10	J	60	Total 478	C 313	N 81	O 84	0	0	0

- Molecule 11 is a protein called Ubiquinol-cytochrome C reductase complex 6.4 kDa protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
11	K	51	Total 421	C 280	N 76	O 64	S 1	0	0	0

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
K	22	GLN	SER	SEE REMARK 999	UNP P07552

- Molecule 12 is PROTOPORPHYRIN IX CONTAINING FE (three-letter code: HEM) (formula: $C_{34}H_{32}FeN_4O_4$).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
12	C	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
12	C	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		
12	D	1	Total	C	Fe	N	O	0	0
			43	34	1	4	4		

- Molecule 13 is FE2/S2 (INORGANIC) CLUSTER (three-letter code: FES) (formula: Fe_2S_2).
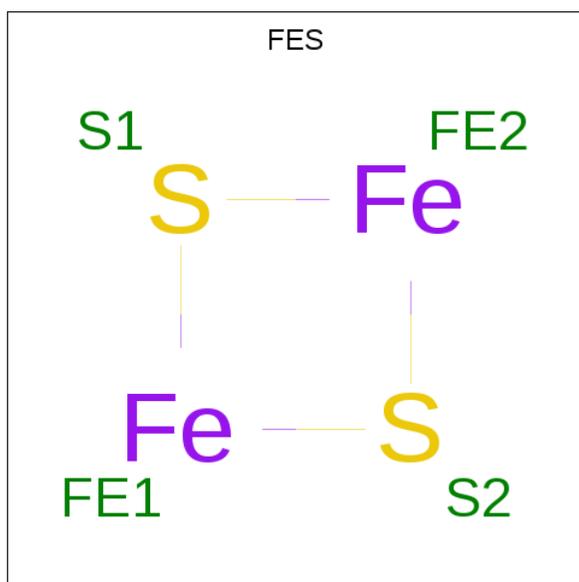
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
13	E	1	Total	Fe	S	0	0
			4	2	2		

- Molecule 14 is water.

| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
14	A	99	Total 99	O 99	0	0
14	B	152	Total 152	O 152	0	0
14	C	64	Total 64	O 64	0	0
14	D	43	Total 43	O 43	0	0
14	E	8	Total 8	O 8	0	0
14	F	37	Total 37	O 37	0	0
14	G	23	Total 23	O 23	0	0
14	H	7	Total 7	O 7	0	0
14	I	5	Total 5	O 5	0	0
14	J	6	Total 6	O 6	0	0
14	K	10	Total 10	O 10	0	0

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 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: Ubiquinol-cytochrome C reductase complex core protein I, mitochondrial
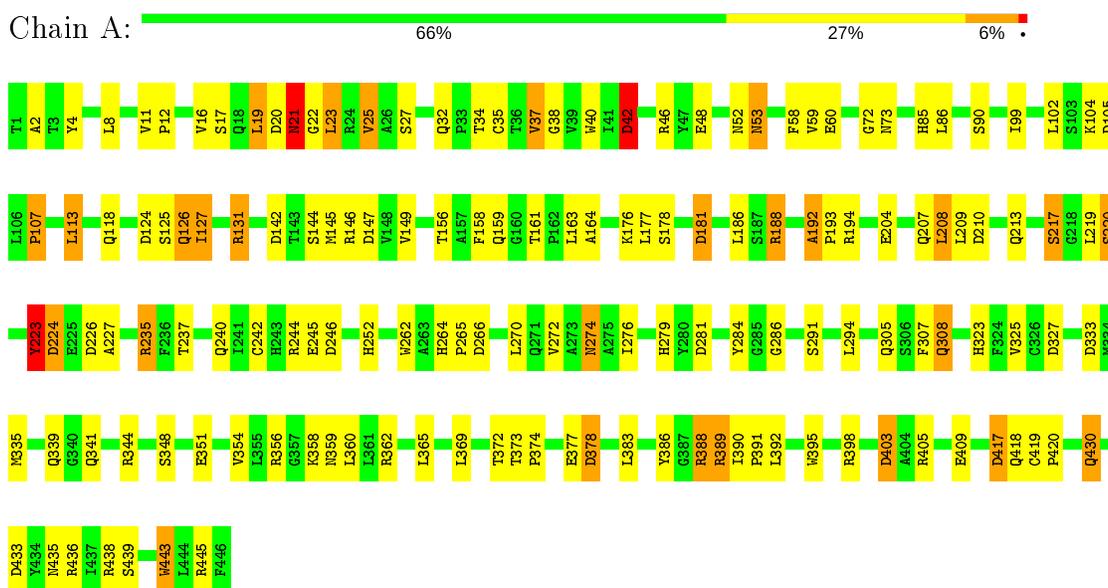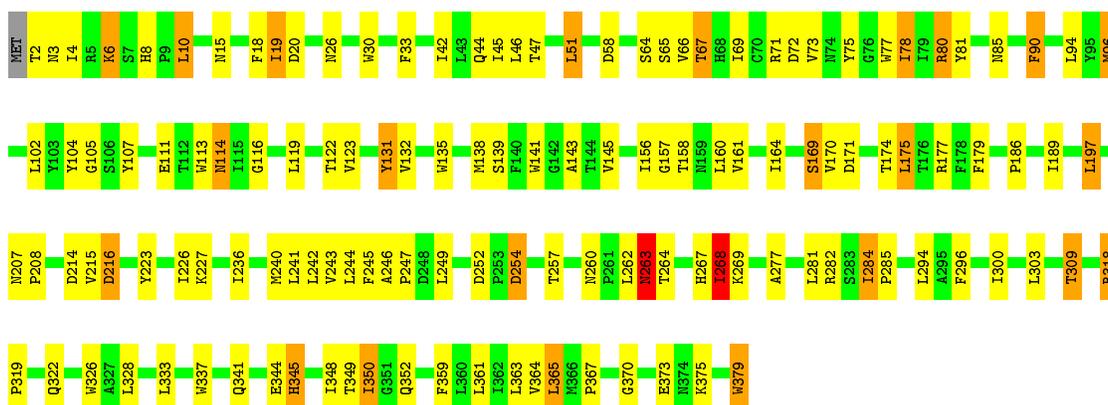

• Molecule 2: Ubiquinol-cytochrome C reductase complex core protein 2, mitochondrial
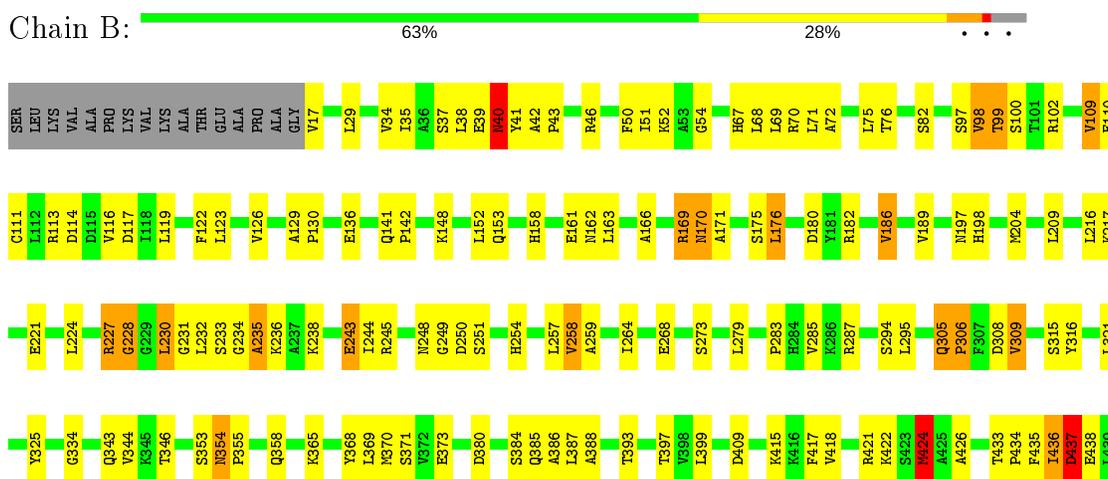
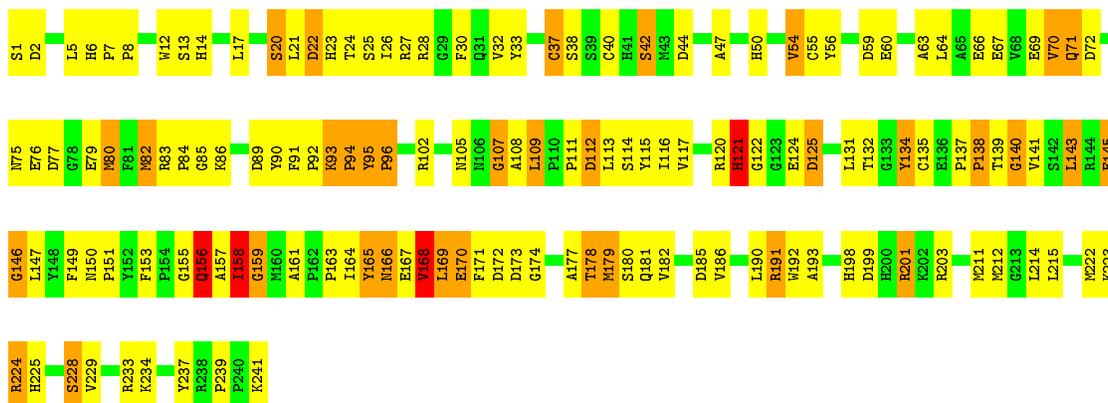• Molecule 3: Cytochrome b

Chain C:

• Molecule 4: cytochrome c1

Chain D:

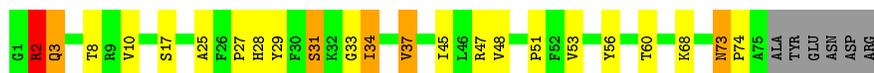• Molecule 5: UBIQUINOL-CYTOCHROME C REDUCTASE IRON-SULFUR SUBUNIT, mito-
chondrial

Chain E:

• Molecule 6: Ubiquinol-cytochrome C reductase complex 14 kDa protein

Chain F:

K110

• Molecule 7: Ubiquinol-cytochrome C reductase complex ubiquinone-binding protein QP-C
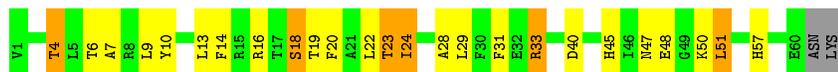
Chain G:

64%   21%   6% · 7%

G1 R2 Q3 T8 R9 V10 S17 A25 F26 P27 H28 Y29 F30 S31 K32 G33 I34 V37 I45 L46 R47 V48 P51 F52 V53 Y56 T60 K68 N73 P74 A75 ALA TYR GLU ASN ASP ARG

• Molecule 8: Ubiquinol-cytochrome C reductase complex 11 kDa protein

Chain H:

58%   21%   6% · 14%

GLY ASP PRO LYS GLU GLU GLU GLU GLU GLU E12 L17 R21 Q26 L27 L37 E38 L39 C40 D41 E42 R43 Q49 E52 D53 L58 L59 D60 F61 L62 R65 D66 H67 C68 V69 L73 F74 N75 K78

• Molecule 9: Ubiquinol-cytochrome C reductase 8 kDa protein

Chain I:

19%   42%   35% ·

M1 L2 S3 V4 A5 A6 R7 S8 G9 P10 F11 A12 P13 V14 L15 S16 A17 T18 S19 R20 G21 V22 A23 Q24 A25 L26 R27 P28 L29 V30 Q31 V34 P35 A36 T37 S38 E39 S40 P41 V42 L43 D44 L45 K46 R47 S48 V49 L50 C51 R52 E53 R56 G57

• Molecule 10: Ubiquinol-cytochrome C reductase complex 7.2 kDa protein

Chain J:

56%   31%   10% ·

V1 T4 L5 T6 A7 R8 L9 Y10 L13 F14 R15 R16 T17 S18 T19 F20 A21 L22 T23 I24 A28 L29 F30 F31 E32 R33 D40 H45 I46 N47 E48 G49 K50 L51 H57 E60 ASN LYS

• Molecule 11: Ubiquinol-cytochrome C reductase complex 6.4 kDa protein

Chain K:

57%   23%   11% 9%

M1 R4 R11 Q12 R15 V18 P19 T20 L23 W24 V27 W34 D37 W38 R39 L40 I41 L42 D43 W44 Y47 I48 K51 PHE LYS LYS ASP ASP

4 Data and refinement statistics (i)

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

Property	Value	Source
Space group	I 41 2 2	Depositor
Cell constants a, b, c, α, β, γ	154.32Å 154.32Å 593.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.40	Depositor
% Data completeness (in resolution range)	85.8 (20.00-2.40)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.237 , 0.285	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	17049	wwPDB-VP
Average B, all atoms (Å^2)	24.0	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: HEM, FES

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	0.68	0/3531	0.91	16/4792 (0.3%)
2	B	0.85	2/3232 (0.1%)	0.93	10/4386 (0.2%)
3	C	0.64	1/3100 (0.0%)	0.84	6/4242 (0.1%)
4	D	0.56	0/1977	0.97	15/2684 (0.6%)
5	E	0.51	0/1553	0.90	10/2100 (0.5%)
6	F	0.79	0/930	0.93	3/1246 (0.2%)
7	G	0.67	0/649	0.78	0/878
8	H	0.47	0/553	0.90	5/741 (0.7%)
9	I	0.87	0/411	1.33	4/558 (0.7%)
10	J	0.59	0/490	0.82	1/665 (0.2%)
11	K	0.53	0/436	0.83	2/598 (0.3%)
All	All	0.68	3/16862 (0.0%)	0.91	72/22890 (0.3%)

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
2	B	1	0
3	C	1	0
4	D	1	0
7	G	1	0
9	I	2	0
All	All	6	0

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	424	MET	SD-CE	-6.85	1.39	1.77
2	B	258	VAL	CB-CG1	-6.53	1.39	1.52

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	379	TRP	CB-CG	-5.18	1.41	1.50

The worst 5 of 72 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	159	GLY	N-CA-C	8.66	134.76	113.10
5	E	71	MET	N-CA-C	8.40	133.67	111.00
6	F	34	ASP	CB-CG-OD2	7.77	125.29	118.30
2	B	114	ASP	CB-CG-OD2	7.47	125.02	118.30
4	D	122	GLY	N-CA-C	-7.27	94.92	113.10

5 of 6 chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
2	B	305	GLN	CA
3	C	345	HIS	CA
4	D	158	ILE	CA
7	G	2	ARG	CA
9	I	25	ALA	CA

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	3458	0	3356	99	0
2	B	3172	0	3152	114	0
3	C	3003	0	3065	106	0
4	D	1918	0	1870	114	0
5	E	1519	0	1503	37	0
6	F	911	0	904	25	0
7	G	628	0	636	21	0
8	H	548	0	532	11	0
9	I	406	0	437	80	0
10	J	478	0	463	28	0
11	K	421	0	428	18	0

Continued from previous page...

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
12	C	86	0	60	10	0
12	D	43	0	30	3	0
13	E	4	0	0	0	0
14	A	99	0	0	11	0
14	B	152	0	0	13	1
14	C	64	0	0	3	0
14	D	43	0	0	7	0
14	E	8	0	0	2	0
14	F	37	0	0	4	0
14	G	23	0	0	2	0
14	H	7	0	0	0	0
14	I	5	0	0	1	0
14	J	6	0	0	0	0
14	K	10	0	0	1	0
All	All	17049	0	16436	571	1

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 17.

The worst 5 of 571 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)
14:A:519:HOH:O	7:G:10:VAL:HB	1.40	1.18
1:A:244:ARG:HG2	14:A:519:HOH:O	1.46	1.15
2:B:227:ARG:HG2	14:B:479:HOH:O	1.48	1.14
4:D:169:LEU:HD11	4:D:177:ALA:HB3	1.22	1.12
4:D:169:LEU:HD11	4:D:177:ALA:CB	1.79	1.12

All (1) 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)
14:B:549:HOH:O	14:B:586:HOH:O[6_565]	1.68	0.52

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	444/446 (100%)	408 (92%)	26 (6%)	10 (2%)	6	7
2	B	421/439 (96%)	386 (92%)	24 (6%)	11 (3%)	5	5
3	C	376/379 (99%)	330 (88%)	41 (11%)	5 (1%)	12	17
4	D	239/241 (99%)	185 (77%)	30 (13%)	24 (10%)	0	0
5	E	194/196 (99%)	175 (90%)	14 (7%)	5 (3%)	5	5
6	F	103/110 (94%)	98 (95%)	3 (3%)	2 (2%)	8	10
7	G	73/81 (90%)	64 (88%)	6 (8%)	3 (4%)	3	2
8	H	65/78 (83%)	53 (82%)	7 (11%)	5 (8%)	1	0
9	I	55/57 (96%)	22 (40%)	19 (34%)	14 (26%)	0	0
10	J	58/62 (94%)	45 (78%)	11 (19%)	2 (3%)	3	3
11	K	49/56 (88%)	41 (84%)	7 (14%)	1 (2%)	7	9
All	All	2077/2145 (97%)	1807 (87%)	188 (9%)	82 (4%)	3	2

5 of 82 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	72	GLY
1	A	227	ALA
2	B	171	ALA
2	B	305	GLN
2	B	436	ILE

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	370/370 (100%)	331 (90%)	39 (10%)	7	9
2	B	332/343 (97%)	296 (89%)	36 (11%)	6	9
3	C	326/327 (100%)	285 (87%)	41 (13%)	4	5
4	D	206/206 (100%)	171 (83%)	35 (17%)	2	2
5	E	168/168 (100%)	155 (92%)	13 (8%)	13	20
6	F	96/98 (98%)	84 (88%)	12 (12%)	4	5
7	G	66/71 (93%)	56 (85%)	10 (15%)	3	3
8	H	64/74 (86%)	58 (91%)	6 (9%)	8	13
9	I	44/44 (100%)	32 (73%)	12 (27%)	0	0
10	J	46/52 (88%)	39 (85%)	7 (15%)	3	3
11	K	41/46 (89%)	33 (80%)	8 (20%)	1	1
All	All	1759/1799 (98%)	1540 (88%)	219 (12%)	4	5

5 of 219 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	175	LEU
4	D	42	SER
9	I	49	VAL
3	C	197	LEU
3	C	328	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 53 such sidechains are listed below:

Mol	Chain	Res	Type
2	B	174	ASN
2	B	362	ASN
7	G	64	GLN
2	B	197	ASN
2	B	305	GLN

5.3.3 RNA ⓘ

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)

4 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	#$|Z| > 2$
12	HEM	C	381	3	27,50,50	2.95	14 (51%)	17,82,82	1.55	1 (5%)
12	HEM	C	382	3	27,50,50	2.63	15 (55%)	17,82,82	2.00	6 (35%)
12	HEM	D	242	4	27,50,50	2.84	16 (59%)	17,82,82	1.91	6 (35%)
13	FES	E	197	5	0,4,4	0.00	-	-		

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
12	HEM	C	381	3	-	2/6/54/54	-
12	HEM	C	382	3	-	3/6/54/54	-
12	HEM	D	242	4	-	0/6/54/54	-
13	FES	E	197	5	-	-	0/1/1/1

The worst 5 of 45 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
12	C	381	HEM	C3C-C2C	-6.61	1.31	1.40

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
12	C	381	HEM	C3B-C2B	-6.05	1.32	1.40
12	D	242	HEM	C3C-C2C	-5.65	1.32	1.40
12	C	382	HEM	C3B-C2B	-5.14	1.33	1.40
12	D	242	HEM	C3B-C2B	-4.84	1.33	1.40

The worst 5 of 13 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
12	C	381	HEM	C4C-C3C-C2C	4.72	110.20	106.90
12	C	382	HEM	C1D-C2D-C3D	3.96	109.75	107.00
12	D	242	HEM	C1D-C2D-C3D	3.76	109.61	107.00
12	C	382	HEM	CMD-C2D-C1D	-3.58	122.95	128.46
12	D	242	HEM	CAA-CBA-CGA	-2.90	107.80	112.67

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
12	C	382	HEM	C1A-C2A-CAA-CBA
12	C	382	HEM	C3A-C2A-CAA-CBA
12	C	381	HEM	C3D-CAD-CBD-CGD
12	C	382	HEM	C2A-CAA-CBA-CGA
12	C	381	HEM	C2A-CAA-CBA-CGA

There are no ring outliers.
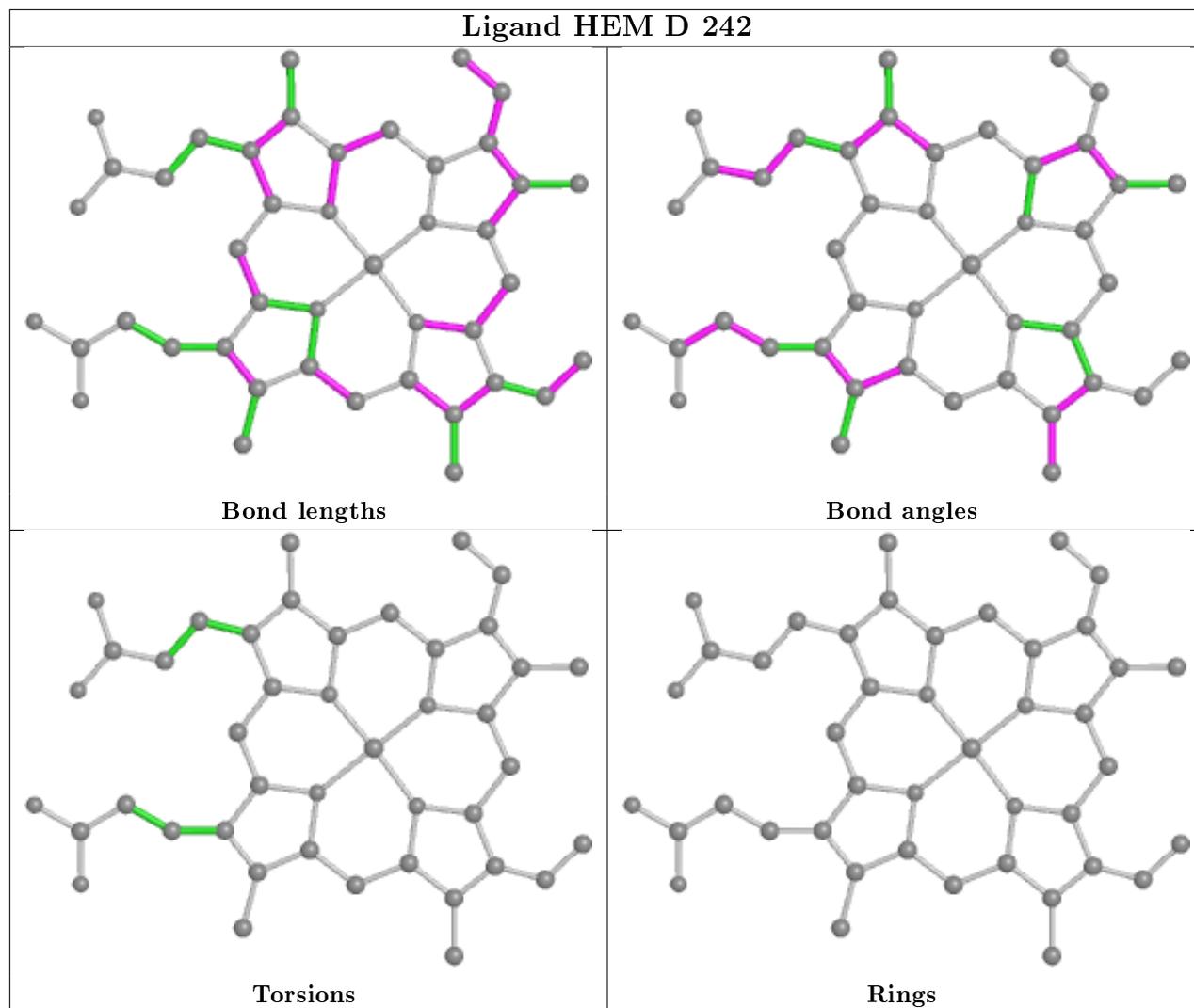
3 monomers are involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
12	C	381	HEM	5	0
12	C	382	HEM	5	0
12	D	242	HEM	3	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and

any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand HEM C 381

Bond lengths

Bond angles

Torsions

Rings

Ligand HEM C 382

Bond lengths

Bond angles

Torsions

Rings

Ligand HEM D 242

Bond lengths

Bond angles

Torsions

Rings
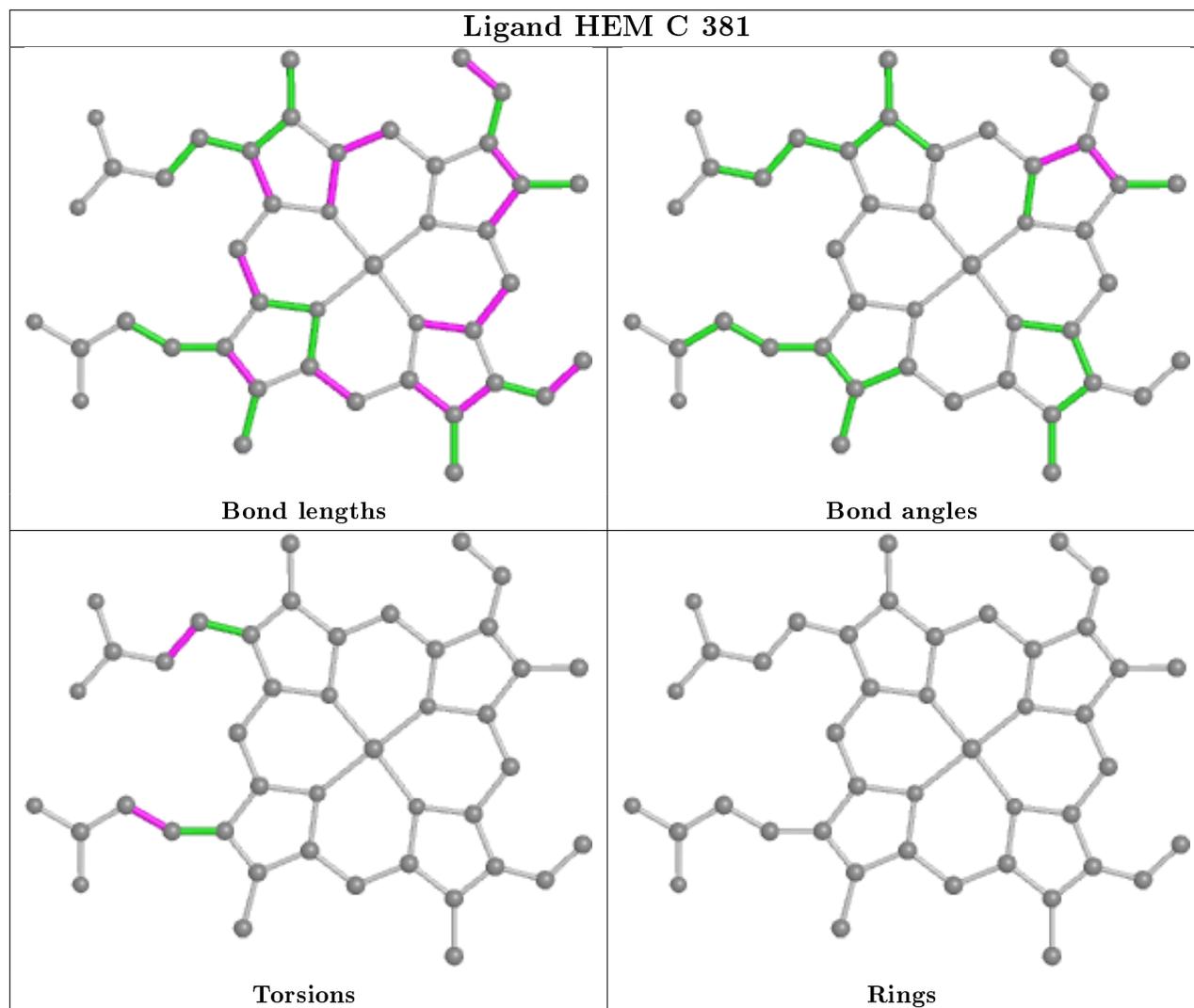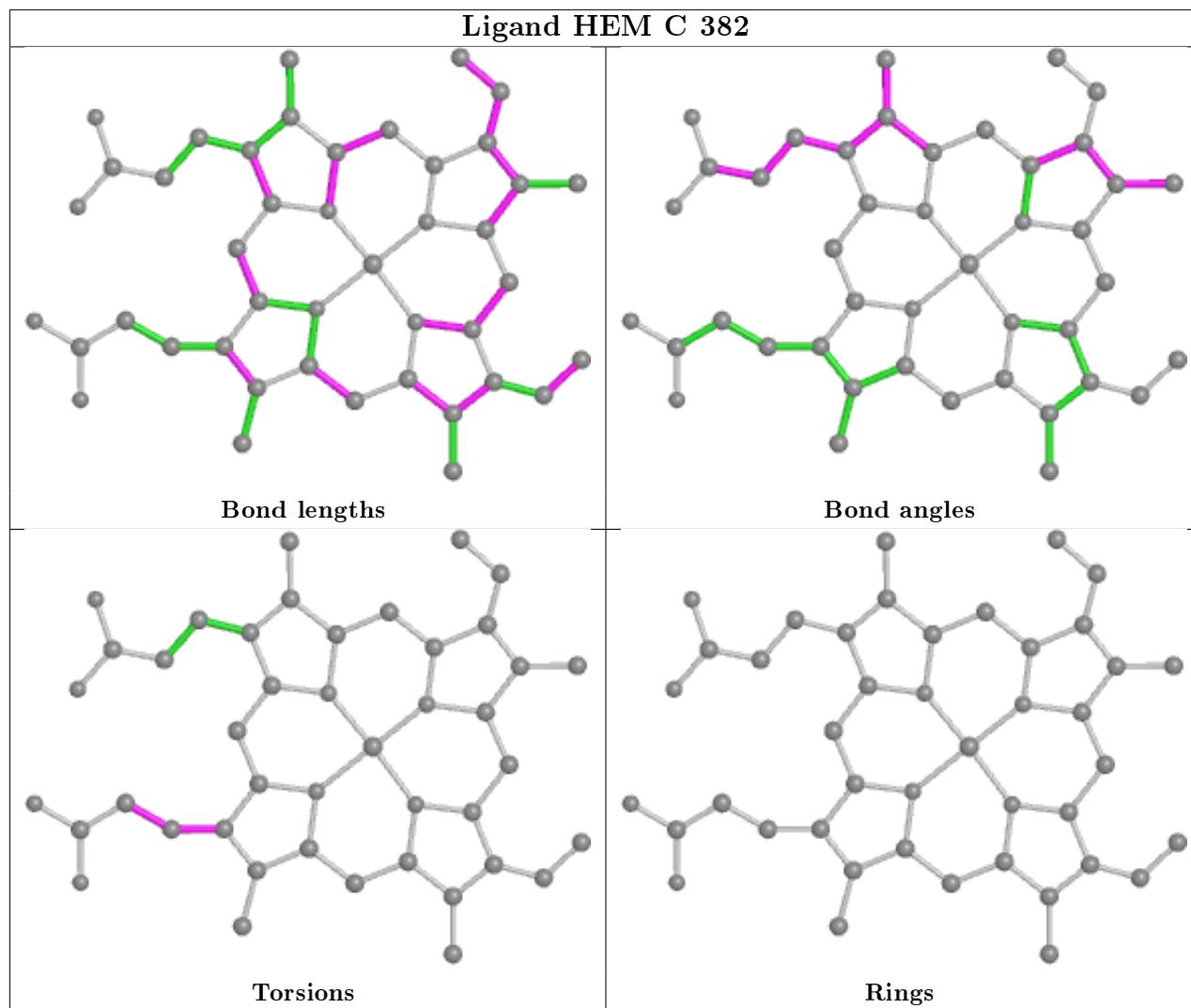
5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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.