



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 06:17 PM UTC

PDB ID : 3Q52 / pdb_00003q52
Title : Structure of phosphorylated PAK1 kinase domain
Authors : Wang, J.; Wu, J.-W.; Wang, Z.-X.
Deposited on : 2010-12-26
Resolution : 1.80 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
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

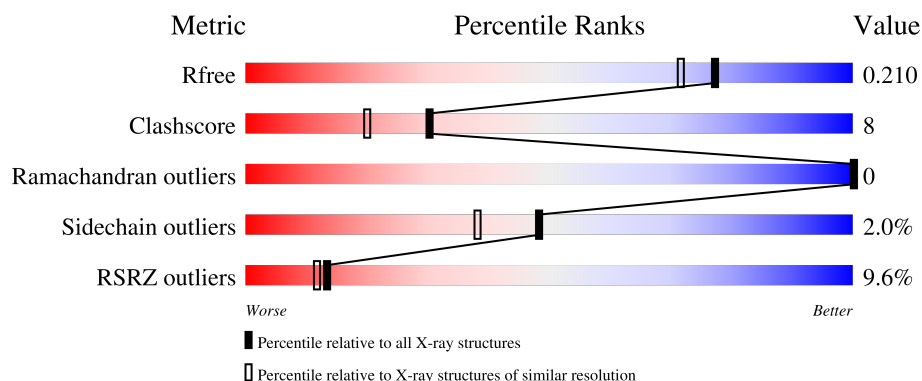
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.80 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	7662 (1.80-1.80)
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)
RSRZ outliers	180081	7663 (1.80-1.80)

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	A	306	9% 73% 20% . .

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2571 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 Serine/threonine-protein kinase PAK 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	293	Total	C	N	O	P	S	0	0	0
			2300	1455	385	443	1	16			

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	299	ARG	LYS	engineered mutation	UNP Q13153
A	516	ILE	LEU	engineered mutation	UNP Q13153
A	546	LEU	-	expression tag	UNP Q13153
A	547	GLU	-	expression tag	UNP Q13153
A	548	HIS	-	expression tag	UNP Q13153
A	549	HIS	-	expression tag	UNP Q13153
A	550	HIS	-	expression tag	UNP Q13153
A	551	HIS	-	expression tag	UNP Q13153
A	552	HIS	-	expression tag	UNP Q13153
A	553	HIS	-	expression tag	UNP Q13153

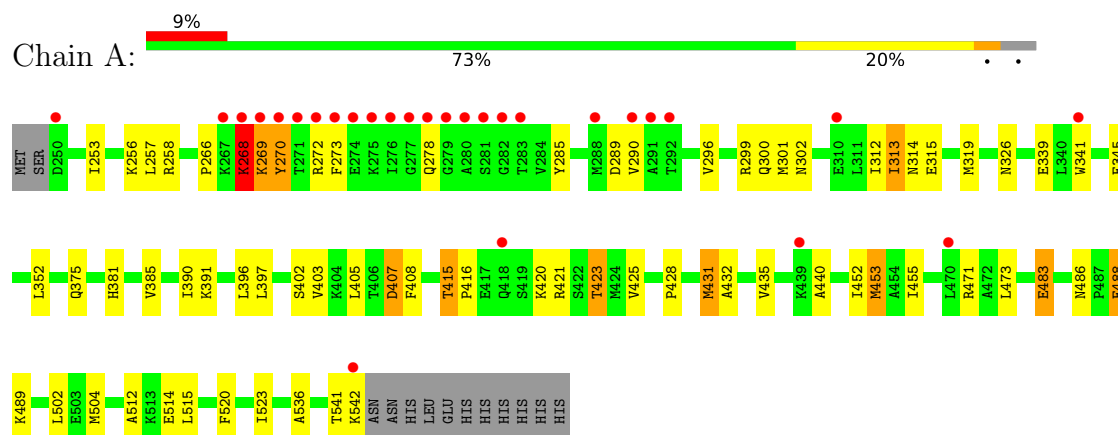
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	271	Total	O	0	0
			271	271		

3 Residue-property plots

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: Serine/threonine-protein kinase PAK 1



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	52.62Å 103.05Å 122.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.65 – 1.80 30.65 – 1.80	Depositor EDS
% Data completeness (in resolution range)	94.3 (30.65-1.80) 99.4 (30.65-1.80)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.98 (at 1.80Å)	Xtriage
Refinement program	PHENIX (phenix.refine)	Depositor
R, R_{free}	0.188 , 0.214 (Not available) , 0.210	Depositor DCC
R_{free} test set	1544 reflections (4.94%)	wwPDB-VP
Wilson B-factor (Å ²)	18.9	Xtriage
Anisotropy	0.415	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 51.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	2571	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.30% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: TPO

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	1.33	36/2326 (1.5%)	0.98	8/3144 (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
1	A	0	1

All (36) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	453	MET	SD-CE	-7.65	1.60	1.79
1	A	385	VAL	C-O	-7.57	1.16	1.24
1	A	407	ASP	C-O	-6.95	1.15	1.24
1	A	396	LEU	C-O	-6.84	1.15	1.23
1	A	415	THR	C-O	-6.75	1.17	1.24
1	A	299	ARG	C-O	-6.66	1.16	1.24
1	A	512	ALA	CA-CB	-6.45	1.43	1.53
1	A	431	MET	C-N	-6.36	1.23	1.33
1	A	408	PHE	C-O	-6.33	1.15	1.24
1	A	489	LYS	C-O	-6.22	1.16	1.24
1	A	403	VAL	C-O	-6.17	1.17	1.24
1	A	512	ALA	C-O	-6.03	1.17	1.24
1	A	296	VAL	C-O	-6.00	1.17	1.23
1	A	483	GLU	C-O	-5.96	1.16	1.23
1	A	313	ILE	C-O	-5.93	1.17	1.24
1	A	345	GLU	C-O	-5.65	1.16	1.23
1	A	455	ILE	C-O	-5.60	1.17	1.24
1	A	405	LEU	C-O	-5.58	1.16	1.23

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	302	ASN	C-O	-5.55	1.17	1.24
1	A	514	GLU	C-O	-5.50	1.17	1.24
1	A	352	LEU	C-O	-5.47	1.17	1.24
1	A	453	MET	CB-CG	-5.46	1.36	1.52
1	A	432	ALA	C-O	-5.45	1.16	1.24
1	A	257	LEU	C-N	-5.42	1.25	1.33
1	A	269	LYS	C-O	-5.38	1.17	1.24
1	A	486	ASN	C-O	-5.34	1.18	1.24
1	A	536	ALA	CA-CB	-5.28	1.45	1.53
1	A	339	GLU	C-O	-5.27	1.17	1.24
1	A	314	ASN	C-O	-5.26	1.18	1.24
1	A	504	MET	C-O	-5.25	1.17	1.24
1	A	428	PRO	C-O	-5.23	1.17	1.24
1	A	402	SER	C-O	-5.18	1.17	1.23
1	A	515	LEU	C-O	-5.18	1.17	1.24
1	A	453	MET	C-O	-5.08	1.18	1.24
1	A	452	ILE	C-O	-5.04	1.18	1.24
1	A	381	HIS	C-O	-5.03	1.18	1.24

All (8) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	269	LYS	N-CA-C	11.12	124.71	111.82
1	A	270	TYR	N-CA-C	7.30	120.79	108.90
1	A	268	LYS	N-CA-C	-6.10	103.58	111.02
1	A	397	LEU	N-CA-C	5.86	118.95	109.40
1	A	502	LEU	N-CA-C	5.67	119.19	112.72
1	A	431	MET	N-CA-C	5.33	118.61	110.20
1	A	471	ARG	CG-CD-NE	-5.27	100.41	112.00
1	A	425	VAL	CB-CA-C	-5.17	105.59	110.65

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	258	ARG	Mainchain

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	2300	0	2331	39	0
2	A	271	0	0	2	0
All	All	2571	0	2331	39	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 8.

All (39) 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:391:LYS:CA	1:A:453:MET:HE2	1.73	1.17
1:A:391:LYS:C	1:A:453:MET:HE2	1.82	1.03
1:A:391:LYS:HA	1:A:453:MET:HE2	1.45	0.95
1:A:391:LYS:CA	1:A:453:MET:CE	2.52	0.88
1:A:301:MET:HE1	1:A:312:ILE:HD13	1.56	0.85
1:A:391:LYS:C	1:A:453:MET:CE	2.59	0.74
1:A:391:LYS:N	1:A:453:MET:CE	2.57	0.67
1:A:300:GLN:NE2	1:A:341:TRP:CZ2	2.65	0.65
1:A:268:LYS:HE3	1:A:269:LYS:N	2.11	0.64
1:A:391:LYS:HA	1:A:453:MET:CE	2.24	0.64
1:A:268:LYS:HE3	1:A:268:LYS:C	2.25	0.61
1:A:421:ARG:HD2	1:A:423:TPO:O1P	2.01	0.61
1:A:390:ILE:HG22	1:A:453:MET:HE3	1.85	0.59
1:A:431:MET:HE3	1:A:435:VAL:HG11	1.83	0.58
1:A:541:THR:O	1:A:542:LYS:HG3	2.04	0.58
1:A:270:TYR:O	1:A:273:PHE:HE2	1.87	0.57
1:A:326:ASN:HD21	1:A:375:GLN:HE21	1.53	0.56
1:A:415:THR:HB	1:A:416:PRO:CD	2.35	0.56
1:A:266:PRO:HG3	1:A:341:TRP:CD2	2.42	0.54
1:A:273:PHE:HB3	1:A:285:TYR:HD1	1.71	0.54
1:A:431:MET:CE	1:A:435:VAL:HG11	2.39	0.53
1:A:326:ASN:ND2	1:A:375:GLN:HE21	2.08	0.51
1:A:391:LYS:N	1:A:453:MET:HE1	2.26	0.50
1:A:273:PHE:HB3	1:A:285:TYR:CD1	2.47	0.48
1:A:483:GLU:HG2	2:A:591:HOH:O	2.14	0.47
1:A:256:LYS:HG2	1:A:313:ILE:HD13	1.97	0.46
1:A:488:GLU:H	1:A:488:GLU:CD	2.22	0.46
1:A:289:ASP:OD1	1:A:289:ASP:C	2.58	0.46
1:A:266:PRO:CG	1:A:341:TRP:CE3	2.99	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:420:LYS:CD	1:A:440:ALA:HB1	2.48	0.44
1:A:541:THR:O	1:A:542:LYS:CB	2.66	0.44
1:A:407:ASP:HA	2:A:73:HOH:O	2.17	0.43
1:A:473:LEU:HD12	1:A:473:LEU:HA	1.73	0.43
1:A:272:ARG:HE	1:A:272:ARG:HB2	1.51	0.43
1:A:520:PHE:O	1:A:523:ILE:HG12	2.19	0.42
1:A:541:THR:C	1:A:542:LYS:HG3	2.43	0.42
1:A:415:THR:HB	1:A:416:PRO:HD2	2.01	0.42
1:A:315:GLU:HG2	1:A:319:MET:HE2	2.01	0.42
1:A:268:LYS:C	1:A:268:LYS:CE	2.92	0.41

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	A	290/306 (95%)	283 (98%)	7 (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	253/266 (95%)	248 (98%)	5 (2%)	48	38

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	253	ILE
1	A	268	LYS
1	A	278	GLN
1	A	290	VAL
1	A	488	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	326	ASN
1	A	383	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

1 non-standard protein/DNA/RNA residue is 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	$\# Z > 2$
1	TPO	A	423	1	8,10,11	2.39	3 (37%)	10,14,16	1.70	3 (30%)

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
1	TPO	A	423	1	-	1/9/11/13	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	423	TPO	O-C	4.24	1.36	1.20
1	A	423	TPO	P-O3P	-3.54	1.41	1.54
1	A	423	TPO	P-OG1	2.91	1.64	1.59

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	423	TPO	O-C-CA	-4.03	114.41	124.77
1	A	423	TPO	CG2-CB-CA	-2.42	108.55	113.26
1	A	423	TPO	O3P-P-O2P	2.27	116.31	107.80

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	423	TPO	O-C-CA-CB

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	423	TPO	1	0

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 ⓘ

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	292/306 (95%)	0.28	28 (9%) 13 12	12, 22, 59, 82	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	250	ASP	5.2
1	A	290	VAL	4.4
1	A	276	ILE	4.3
1	A	275	LYS	4.1
1	A	281	SER	4.0
1	A	271	THR	3.9
1	A	268	LYS	3.7
1	A	277	GLY	3.6
1	A	291	ALA	3.5
1	A	273	PHE	3.3
1	A	278	GLN	3.1
1	A	542	LYS	2.9
1	A	310	GLU	2.9
1	A	280	ALA	2.8
1	A	439	LYS	2.7
1	A	279	GLY	2.7
1	A	288	MET	2.6
1	A	272	ARG	2.5
1	A	274	GLU	2.5
1	A	470	LEU	2.4
1	A	341	TRP	2.4
1	A	283	THR	2.3
1	A	282	GLY	2.3
1	A	418	GLN	2.3
1	A	269	LYS	2.3
1	A	270	TYR	2.1
1	A	292	THR	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	267	LYS	2.0

6.2 Non-standard residues in protein, DNA, RNA chains [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, 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	B-factors(Å ²)	Q<0.9
1	TPO	A	423	11/12	0.97	0.06	20,24,32,33	0

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.