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Dichlorido[1,1-(diphenylphosphino)hydrazide]-palladium(II) dichloromethane monosolvate

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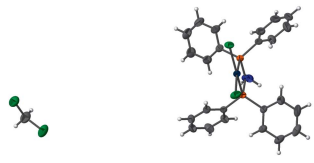
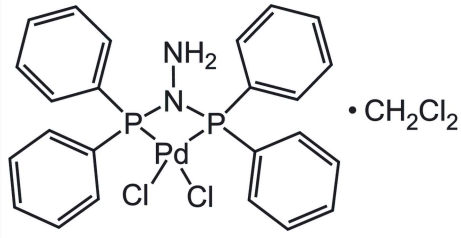
In the title compound, $[PdCl_2(C_{24}H_{22}N_2P_2)]\cdot CH_2Cl_2$, the palladium(II) atom is surrounded by a chelating P—N—P ligand $Ph_2P—N(NH_2)—PPh_2$ containing a hydrazine entity and two chlorido ligands in a distorted square-planar coordination geometry. Beside the complex molecule, the asymmetric unit contains a co-crystallized dichloromethane molecule. The contributions of further disordered solvent molecules were removed from the diffraction data using the SQUEEZE [Spek (2015). *Acta Cryst.* C**71**, 9–18] procedure.

3D view



Chemical scheme



Structure description

The distorted square-planar coordinated palladium(II) atom in the $[PdCl_2(C_{24}H_{22}N_2P_2)]$ complex molecule (Fig. 1) is ligated by two chlorido and a chelating P—N—P ligand, which contains a hydrazine entity. The bite angle [P2—Pd1—P1 = 72.689 (15)°] is rather acute as found in other Pd^{II} complexes with the $Ph_2P—N(NR_2)—PPh_2$ ligand {72.93 (4)° for $[PdCl_2\{(Ph_2P)_2NNC_4H_8O\}]$ and 72.82 (5)° for $[PdCl_2\{(Ph_2P)_2NNC_4H_8NHCH_3\}]Cl$; Gholivand *et al.*, 2016}. The P—N—P angle is 102.38 (7)°. Both, the Pd—Cl bond lengths [Pd1—Cl1 = 2.3531 (4) Å, Pd1—Cl2 = 2.3599 (4) Å] and Pd—P distances [Pd1—P1 = 2.2319 (4) Å, Pd1—P2 = 2.2063 (4) Å] are very similar to those in the related complexes detailed above. The N—N distance within the hydrazine unit is 1.4108 (18) Å. The P—N bond lengths [P1—N1 = 1.6968 (13) Å, P2—N1 = 1.6787 (14) Å] are significantly shortened when compared to the sum of the covalent radii [Σr_{cov}(P—N) = 1.82 Å; Pyykkö, 2015] but again are similar to the values found in the two complexes mentioned previously, where the P—N distances range from 1.701 (4) to 1.714 (3) Å. A co-crystallized dichloromethane molecule appears in the asymmetric unit along with the complex molecule. The contributions of further disordered solvent molecules were removed from the diffraction data with SQUEEZE in *PLATON* (Spek, 2015). In the crystal, molecules

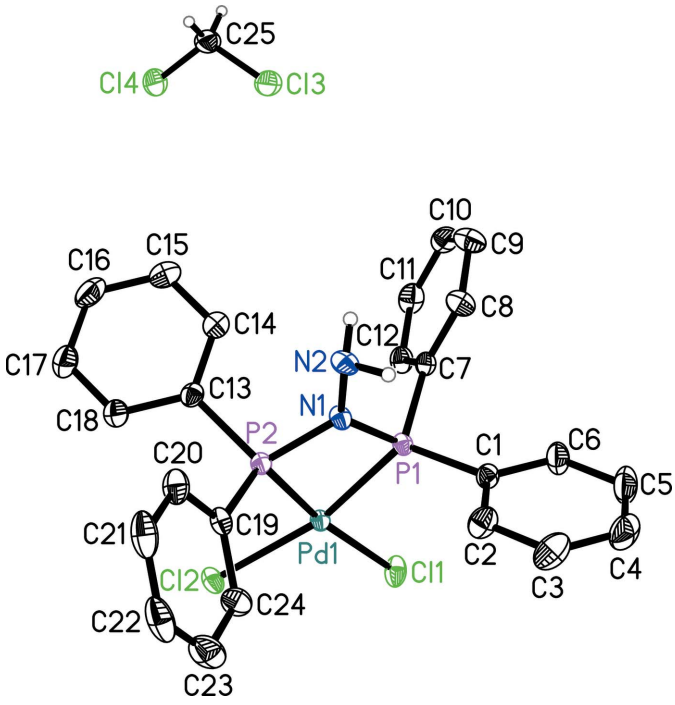


Figure 1
Molecular structure of the title compound with atom labelling and displacement ellipsoids drawn at the 30% probability level. C-bound hydrogen atoms are omitted for clarity.

of the palladium complex and the solvent dichloromethane are linked by weak N—H···Cl hydrogen bonds (Table 1).

Synthesis and crystallization

A solution of $Pd(PhCN)_2Cl_2$ (0.107 g, 0.28 mmol) and $(Ph_2P)_2N—NH_2$ (0.112 g, 0.28 mmol) (Höhne *et al.*, 2018) in CH_2Cl_2 was stirred overnight at room temperature. CH_2Cl_2 was removed under vacuum and the yellow residue washed with *n*-hexane. Recrystallization from CH_2Cl_2/Et_2O gave pale-yellow crystals. Yield 0.129 g (80%). ^{31}P NMR (121 MHz, $CDCl_3$, 298 K): δ = 65.0 p.p.m.. Elemental analysis calculated (%) for $C_{24}H_{22}Cl_2N_2P_2Pd$ (577.72): C 49.90, H 3.84, N 4.85. Found: C 49.44, H 3.91, N 4.95.

Refinement

Crystal data, data collection and structure refinement details are summarized in Table 2. AFIX 66 instructions were used to improve the geometry of the phenyl rings. The contributions of other disordered solvent molecules in addition to the dichloromethane monosolvate were removed from the diffraction data with SQUEEZE in *PLATON* (Spek, 2015). SQUEEZE estimated the electron counts in two voids of 146 Å^3 volume to be 42.

Table 1
Hydrogen-bond geometry (Å, °).

D—H···A	D—H	H···A	D···A	D—H···A
N2—H2A···Cl1^{i}	0.91 (2)	2.63 (2)	3.3066 (16)	132.0 (17)
N2—H2B···Cl2^{i}	0.82 (2)	2.58 (2)	3.3495 (17)	157 (2)

Symmetry code: (i) $x+\frac{1}{2}, -y+\frac{1}{2}, z+\frac{1}{2}$.

Table 2
Experimental details.

Crystal data	
Chemical formula	$[PdCl_2(C_{24}H_{22}N_2P_2)]\cdot CH_2Cl_2$
M_r	662.60
Crystal system, space group	Monoclinic, $P2_1/n$
Temperature (K)	200
a, b, c (Å)	11.7085 (3), 16.9319 (3), 15.2399 (4)
β (°)	105.3240 (19)
V (Å^3)	2913.85 (12)
Z	4
Radiation type	Mo $K\alpha$
μ (mm^{-1})	1.13
Crystal size (mm)	0.45 × 0.35 × 0.11
Data collection	
Diffractometer	Stoe IPDS II
Absorption correction	Numerical (*X-SHAPE*; Stoe & Cie, 2005)
T_{min}, T_{max}	0.621, 0.897
No. of measured, independent and observed [$I > 2\sigma(I)$] reflections	50295, 7032, 6060
R_{int}	0.027
(sin $\theta/\lambda)_{max}$ (Å^{-1})	0.661
Refinement	
$R[F^2 > 2\sigma(F^2)]$, $wR(F^2)$, S	0.022, 0.057, 1.00
No. of reflections	7032
No. of parameters	265
H-atom treatment	H atoms treated by a mixture of independent and constrained refinement
$\Delta\rho_{max}$, $\Delta\rho_{min}$ (e Å^{-3})	0.45, −0.47

Computer programs: *X-SHAPE* (Stoe & Cie, 2005) and *X-AREA* (Stoe & Cie, 2012), *XP* in *SHELXTL* and *SHELXS97* (Sheldrick, 2008), *SHELXL2014/7* (Sheldrick, 2015) and *publCIF* (Westrip, 2010).

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full crystallographic data

IUCrData (2019). **4**, x181803 [https://doi.org/10.1107/S2414314618018035]

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Crystal data

$PdCl_2[C_{24}H_{22}N_2P_2]\cdot CH_2Cl_2$
$M_r = 662.60$
Monoclinic, $P2_1/n$
$a = 11.7085$ (3) Å
$b = 16.9319$ (3) Å
$c = 15.2399$ (4) Å
$\beta = 105.3240$ (19)°
$V = 2913.85$ (12) Å^3
$Z = 4$
$F(000) = 1328$
$D_x = 1.510$ Mg m^{-3}
Mo $K\alpha$ radiation, $\lambda = 0.71073$ Å
Cell parameters from 16993 reflections
$\theta = 1.8$–29.7°
$\mu = 1.13$ mm^{-1}
$T = 200$ K
Prism, yellow
0.45 × 0.35 × 0.11 mm

Data collection

STOE IPDS II diffractometer
Radiation source: fine-focus sealed tube
Graphite monochromator
ω scans
Absorption correction: numerical (X-SHAPE; Stoe & Cie, 2005)
$T_{min} = 0.621$, $T_{max} = 0.897$
50295 measured reflections
7032 independent reflections
6060 reflections with $I > 2\sigma(I)$
$R_{int} = 0.027$
$\theta_{max} = 28.0°$, $\theta_{min} = 1.8°$
$h = -15\rightarrow15$
$k = -22\rightarrow22$
$l = -20\rightarrow20$

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)] = 0.022$
$wR(F^2) = 0.057$
$S = 1.00$
7032 reflections
265 parameters
0 restraints
Hydrogen site location: mixed
H atoms treated by a mixture of independent and constrained refinement
$w = 1/[\sigma^2(F_o^2) + (0.0388P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
$(\Delta/\sigma)_{max} = 0.001$
$\Delta\rho_{max} = 0.45$ e Å^{-3}
$\Delta\rho_{min} = -0.47$ e Å^{-3}

Special details

Geometry. All esds (except the esd in the dihedral angle between two l.s. planes) are estimated using the full covariance matrix. The cell esds are taken into account individually in the estimation of esds in distances, angles and torsion angles; correlations between esds in cell parameters are only used when they are defined by crystal symmetry. An approximate (isotropic) treatment of cell esds is used for estimating esds involving l.s. planes.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters (Å²)

	x	*y*	*z*	U_{iso}*/U_{eq}
C1	1.16203 (9)	0.24562 (6)	0.24613 (9)	0.0297 (3)
C2	1.19152 (12)	0.16638 (6)	0.24250 (10)	0.0450 (5)
H2	1.1390	0.1266	0.2523	0.054*
C3	1.29786 (13)	0.14534 (6)	0.22455 (12)	0.0593 (6)
H3	1.3180	0.0912	0.2221	0.071*
C4	1.37472 (11)	0.20353 (9)	0.21024 (13)	0.0602 (6)
H4	1.4474	0.1892	0.1980	0.072*
C5	1.34524 (11)	0.28277 (8)	0.21387 (13)	0.0615 (6)
H5	1.3978	0.3225	0.2041	0.074*
C6	1.23890 (11)	0.30381 (5)	0.23181 (11)	0.0451 (5)
H6	1.2187	0.3580	0.2343	0.054*
C7	1.03729 (10)	0.36784 (5)	0.31523 (7)	0.0273 (3)
C8	1.12961 (9)	0.38617 (6)	0.39076 (8)	0.0384 (4)
H8	1.1909	0.3489	0.4134	0.046*
C9	1.13219 (11)	0.45907 (7)	0.43318 (8)	0.0477 (5)
H9	1.1953	0.4716	0.4848	0.057*
C10	1.04245 (12)	0.51364 (5)	0.40006 (9)	0.0443 (5)
H10	1.0442	0.5635	0.4291	0.053*
C11	0.95013 (10)	0.49531 (6)	0.32453 (9)	0.0442 (5)
H11	0.8888	0.5326	0.3019	0.053*
C12	0.94755 (9)	0.42241 (6)	0.28211 (7)	0.0358 (4)
H12	0.8845	0.4099	0.2305	0.043*
C13	0.77590 (10)	0.20421 (7)	0.37647 (8)	0.0303 (3)
C14	0.80666 (10)	0.27162 (7)	0.42952 (9)	0.0432 (4)
H14	0.8776	0.2991	0.4301	0.052*
C15	0.73365 (13)	0.29878 (7)	0.48163 (10)	0.0548 (6)
H15	0.7547	0.3449	0.5179	0.066*
C16	0.62987 (13)	0.25853 (9)	0.48071 (10)	0.0575 (6)
H16	0.5800	0.2771	0.5163	0.069*
C17	0.59911 (10)	0.19112 (9)	0.42767 (11)	0.0546 (6)
H17	0.5282	0.1636	0.4270	0.065*
C18	0.67212 (11)	0.16396 (7)	0.37555 (9)	0.0437 (5)
H18	0.6511	0.1179	0.3393	0.052*
C19	0.86740 (11)	0.06762 (5)	0.30367 (8)	0.0292 (3)
C20	0.87356 (12)	0.02481 (7)	0.38262 (7)	0.0428 (4)
H20	0.8742	0.0516	0.4375	0.051*
C21	0.87878 (14)	−0.05718 (7)	0.38123 (9)	0.0565 (6)
H21	0.8830	−0.0864	0.4352	0.068*
C22	0.87785 (14)	−0.09636 (5)	0.30090 (12)	0.0593 (7)
H22	0.8814	−0.1524	0.2999	0.071*
C23	0.87169 (14)	−0.05356 (7)	0.22195 (9)	0.0582 (6)
H23	0.8710	−0.0803	0.1670	0.070*
C24	0.86646 (13)	0.02843 (7)	0.22334 (7)	0.0417 (4)
H24	0.8623	0.0577	0.1694	0.050*
C25	0.3215 (2)	1.00146 (18)	0.44188 (18)	0.0617 (6)

H25A	0.3387	0.9647	0.4943	0.074*
H25B	0.3328	1.0559	0.4663	0.074*
N1	1.00533 (12)	0.20686 (8)	0.34971 (9)	0.0261 (3)
N2	1.07577 (14)	0.18939 (9)	0.43796 (10)	0.0320 (3)
H2A	1.149 (2)	0.1760 (13)	0.4333 (15)	0.038*
H2B	1.082 (2)	0.2285 (14)	0.4706 (16)	0.038*
P1	1.02368 (4)	0.27021 (2)	0.26825 (3)	0.02381 (8)
P2	0.86725 (4)	0.17321 (2)	0.30531 (3)	0.02387 (8)
Cl1	0.86063 (4)	0.30782 (3)	0.04595 (3)	0.04087 (11)
Cl2	0.65519 (4)	0.18738 (2)	0.11563 (3)	0.03397 (9)
Cl3	0.42219 (6)	0.98440 (5)	0.37823 (5)	0.06769 (18)
Cl4	0.17481 (5)	0.98982 (4)	0.38098 (5)	0.05934 (15)
Pd1	0.84858 (2)	0.23671 (2)	0.17587 (2)	0.02260 (4)

Atomic displacement parameters (Å²)

	U^{11}	U^{22}	U^{33}	U^{12}	U^{13}	U^{23}
C1	0.0232 (8)	0.0348 (8)	0.0307 (8)	0.0029 (6)	0.0063 (6)	0.0013 (6)
C2	0.0492 (12)	0.0383 (10)	0.0525 (12)	0.0087 (9)	0.0224 (10)	0.0052 (9)
C3	0.0608 (15)	0.0577 (14)	0.0662 (15)	0.0288 (12)	0.0289 (13)	0.0071 (12)
C4	0.0356 (12)	0.0852 (18)	0.0626 (15)	0.0183 (12)	0.0181 (11)	−0.0026 (13)
C5	0.0354 (12)	0.0726 (16)	0.0837 (18)	−0.0063 (11)	0.0284 (12)	−0.0042 (14)
C6	0.0316 (10)	0.0434 (11)	0.0644 (14)	−0.0029 (8)	0.0198 (9)	−0.0007 (9)
C7	0.0269 (8)	0.0264 (7)	0.0297 (8)	−0.0012 (6)	0.0096 (6)	0.0032 (6)
C8	0.0397 (10)	0.0319 (9)	0.0380 (10)	0.0008 (7)	0.0003 (8)	0.0004 (7)
C9	0.0589 (14)	0.0376 (10)	0.0408 (11)	−0.0066 (9)	0.0030 (10)	−0.0066 (8)
C10	0.0595 (14)	0.0299 (9)	0.0502 (12)	−0.0036 (9)	0.0262 (11)	−0.0057 (8)
C11	0.0431 (12)	0.0321 (9)	0.0623 (13)	0.0081 (8)	0.0226 (10)	0.0041 (9)
C12	0.0296 (9)	0.0345 (9)	0.0440 (10)	0.0024 (7)	0.0108 (8)	0.0028 (7)
C13	0.0280 (8)	0.0382 (9)	0.0242 (7)	0.0013 (7)	0.0064 (6)	0.0041 (7)
C14	0.0450 (12)	0.0463 (11)	0.0414 (11)	−0.0047 (9)	0.0169 (9)	−0.0047 (9)
C15	0.0620 (15)	0.0597 (14)	0.0487 (12)	−0.0002 (12)	0.0251 (11)	−0.0140 (11)
C16	0.0557 (15)	0.0773 (16)	0.0489 (13)	0.0082 (12)	0.0305 (11)	−0.0038 (11)
C17	0.0401 (12)	0.0717 (15)	0.0587 (14)	−0.0052 (10)	0.0250 (11)	−0.0033 (12)
C18	0.0334 (10)	0.0561 (12)	0.0433 (11)	−0.0075 (9)	0.0129 (8)	−0.0069 (9)
C19	0.0225 (8)	0.0276 (8)	0.0355 (9)	−0.0022 (6)	0.0039 (7)	0.0054 (6)
C20	0.0383 (11)	0.0418 (10)	0.0480 (11)	−0.0009 (8)	0.0109 (9)	0.0156 (9)
C21	0.0400 (12)	0.0423 (11)	0.0863 (18)	0.0007 (9)	0.0152 (12)	0.0338 (12)
C22	0.0352 (11)	0.0272 (9)	0.113 (2)	0.0012 (8)	0.0159 (13)	0.0108 (12)
C23	0.0567 (14)	0.0352 (10)	0.0802 (18)	0.0027 (10)	0.0138 (13)	−0.0131 (11)
C24	0.0462 (12)	0.0316 (9)	0.0459 (11)	0.0012 (8)	0.0095 (9)	−0.0015 (8)
C25	0.0455 (14)	0.0845 (18)	0.0543 (14)	0.0003 (12)	0.0115 (11)	−0.0174 (13)
N1	0.0234 (7)	0.0290 (6)	0.0225 (6)	−0.0021 (5)	−0.0001 (5)	0.0062 (5)
N2	0.0322 (8)	0.0340 (8)	0.0233 (7)	−0.0010 (6)	−0.0044 (6)	0.0040 (6)
P1	0.02071 (19)	0.02514 (18)	0.02432 (18)	−0.00050 (15)	0.00374 (15)	0.00298 (15)
P2	0.0231 (2)	0.02573 (19)	0.02144 (18)	−0.00157 (15)	0.00356 (15)	0.00300 (14)
Cl1	0.0304 (2)	0.0578 (3)	0.0335 (2)	−0.00264 (19)	0.00691 (17)	0.01967 (19)
Cl2	0.0289 (2)	0.0367 (2)	0.0316 (2)	−0.00911 (16)	−0.00041 (16)	0.00507 (16)

Cl3	0.0422 (3)	0.0957 (5)	0.0652 (4)	0.0064 (3)	0.0142 (3)	−0.0215 (3)
Cl4	0.0398 (3)	0.0707 (4)	0.0663 (4)	0.0047 (3)	0.0119 (3)	0.0001 (3)
Pd1	0.02080 (6)	0.02542 (6)	0.02001 (6)	−0.00052 (4)	0.00263 (4)	0.00301 (4)

Geometric parameters (Å, º)

C1—C2	1.3900	C16—C17	1.3900
C1—C6	1.3900	C16—H16	0.9500
C1—P1	1.7888	C17—C18	1.3900
C2—C3	1.3900	C17—H17	0.9500
C2—H2	0.9500	C18—H18	0.9500
C3—C4	1.3900	C19—C20	1.3900
C3—H3	0.9500	C19—C24	1.3900
C4—C5	1.3900	C19—P2	1.7880
C4—H4	0.9500	C20—C21	1.3900
C5—C6	1.3900	C20—H20	0.9500
C5—H5	0.9500	C21—C22	1.3900
C6—H6	0.9500	C21—H21	0.9500
C7—C8	1.3900	C22—C23	1.3900
C7—C12	1.3900	C22—H22	0.9500
C7—P1	1.7917	C23—C24	1.3900
C8—C9	1.3900	C23—H23	0.9500
C8—H8	0.9500	C24—H24	0.9500
C9—C10	1.3900	C25—Cl4	1.734 (3)
C9—H9	0.9500	C25—Cl3	1.738 (3)
C10—C11	1.3900	C25—H25A	0.9900
C10—H10	0.9500	C25—H25B	0.9900
C11—C12	1.3900	N1—N2	1.4108 (18)
C11—H11	0.9500	N1—P2	1.6787 (14)
C12—H12	0.9500	N1—P1	1.6968 (13)
C13—C14	1.3900	N2—H2A	0.91 (2)
C13—C18	1.3900	N2—H2B	0.82 (2)
C13—P2	1.7912	P1—Pd1	2.2319 (4)
C14—C15	1.3900	P1—P2	2.6303 (6)
C14—H14	0.9500	P2—Pd1	2.2063 (4)
C15—C16	1.3900	Cl1—Pd1	2.3531 (4)
C15—H15	0.9500	Cl2—Pd1	2.3599 (4)
C2—C1—C6	120.0	C20—C19—P2	120.62 (7)
C2—C1—P1	118.62 (7)	C24—C19—P2	119.33 (7)
C6—C1—P1	121.38 (7)	C19—C20—C21	120.0
C3—C2—C1	120.0	C19—C20—H20	120.0
C3—C2—H2	120.0	C21—C20—H20	120.0
C1—C2—H2	120.0	C22—C21—C20	120.0
C4—C3—C2	120.0	C22—C21—H21	120.0
C4—C3—H3	120.0	C20—C21—H21	120.0
C2—C3—H3	120.0	C21—C22—C23	120.0
C3—C4—C5	120.0	C21—C22—H22	120.0

C3—C4—H4	120.0	C23—C22—H22	120.0
C5—C4—H4	120.0	C24—C23—C22	120.0
C6—C5—C4	120.0	C24—C23—H23	120.0
C6—C5—H5	120.0	C22—C23—H23	120.0
C4—C5—H5	120.0	C23—C24—C19	120.0
C5—C6—C1	120.0	C23—C24—H24	120.0
C5—C6—H6	120.0	C19—C24—H24	120.0
C1—C6—H6	120.0	Cl4—C25—Cl3	113.86 (14)
C8—C7—C12	120.0	Cl4—C25—H25A	108.8
C8—C7—P1	120.30 (6)	Cl3—C25—H25A	108.8
C12—C7—P1	119.30 (6)	Cl4—C25—H25B	108.8
C9—C8—C7	120.0	Cl3—C25—H25B	108.8
C9—C8—H8	120.0	H25A—C25—H25B	107.7
C7—C8—H8	120.0	N2—N1—P2	124.84 (11)
C8—C9—C10	120.0	N2—N1—P1	132.44 (11)
C8—C9—H9	120.0	P2—N1—P1	102.38 (7)
C10—C9—H9	120.0	N1—N2—H2A	107.7 (14)
C9—C10—C11	120.0	N1—N2—H2B	110.1 (16)
C9—C10—H10	120.0	H2A—N2—H2B	109 (2)
C11—C10—H10	120.0	N1—P1—C1	106.66 (6)
C12—C11—C10	120.0	N1—P1—C7	107.82 (6)
C12—C11—H11	120.0	C1—P1—C7	107.50 (6)
C10—C11—H11	120.0	N1—P1—Pd1	91.61 (5)
C11—C12—C7	120.0	C1—P1—Pd1	123.27 (5)
C11—C12—H12	120.0	C7—P1—Pd1	117.16 (4)
C7—C12—H12	120.0	N1—P1—P2	38.56 (5)
C14—C13—C18	120.0	C1—P1—P2	127.72 (4)
C14—C13—P2	119.23 (7)	C7—P1—P2	118.93 (4)
C18—C13—P2	120.69 (7)	Pd1—P1—P2	53.206 (12)
C13—C14—C15	120.0	N1—P2—C19	109.91 (7)
C13—C14—H14	120.0	N1—P2—C13	108.79 (6)
C15—C14—H14	120.0	C19—P2—C13	107.73 (6)
C14—C15—C16	120.0	N1—P2—Pd1	92.99 (5)
C14—C15—H15	120.0	C19—P2—Pd1	118.36 (4)
C16—C15—H15	120.0	C13—P2—Pd1	117.68 (5)
C17—C16—C15	120.0	N1—P2—P1	39.06 (5)
C17—C16—H16	120.0	C19—P2—P1	128.18 (5)
C15—C16—H16	120.0	C13—P2—P1	120.53 (4)
C16—C17—C18	120.0	Pd1—P2—P1	54.104 (13)
C16—C17—H17	120.0	P2—Pd1—P1	72.689 (15)
C18—C17—H17	120.0	P2—Pd1—Cl1	171.075 (16)
C17—C18—C13	120.0	P1—Pd1—Cl1	98.708 (16)
C17—C18—H18	120.0	P2—Pd1—Cl2	91.915 (15)
C13—C18—H18	120.0	P1—Pd1—Cl2	164.224 (16)
C20—C19—C24	120.0	Cl1—Pd1—Cl2	96.807 (16)
C6—C1—C2—C3	0.0	C2—C1—P1—N1	40.69 (10)
P1—C1—C2—C3	179.37 (11)	C6—C1—P1—N1	−139.95 (9)

C1—C2—C3—C4	0.0	C2—C1—P1—C7	156.12 (8)
C2—C3—C4—C5	0.0	C6—C1—P1—C7	−24.52 (10)
C3—C4—C5—C6	0.0	C2—C1—P1—Pd1	−62.69 (9)
C4—C5—C6—C1	0.0	C6—C1—P1—Pd1	116.67 (8)
C2—C1—C6—C5	0.0	C2—C1—P1—P2	3.85 (11)
P1—C1—C6—C5	−179.35 (11)	C6—C1—P1—P2	−176.79 (7)
C12—C7—C8—C9	0.0	C8—C7—P1—N1	61.04 (9)
P1—C7—C8—C9	−172.65 (9)	C12—C7—P1—N1	−111.66 (8)
C7—C8—C9—C10	0.0	C8—C7—P1—C1	−53.62 (9)
C8—C9—C10—C11	0.0	C12—C7—P1—C1	133.68 (8)
C9—C10—C11—C12	0.0	C8—C7—P1—Pd1	162.46 (6)
C10—C11—C12—C7	0.0	C12—C7—P1—Pd1	−10.24 (8)
C8—C7—C12—C11	0.0	C8—C7—P1—P2	101.51 (7)
P1—C7—C12—C11	172.72 (9)	C12—C7—P1—P2	−71.19 (8)
C18—C13—C14—C15	0.0	N2—N1—P2—C19	−59.36 (15)
P2—C13—C14—C15	176.77 (10)	P1—N1—P2—C19	126.65 (7)
C13—C14—C15—C16	0.0	N2—N1—P2—C13	58.37 (15)
C14—C15—C16—C17	0.0	P1—N1—P2—C13	−115.63 (7)
C15—C16—C17—C18	0.0	N2—N1—P2—Pd1	178.98 (14)
C16—C17—C18—C13	0.0	P1—N1—P2—Pd1	4.98 (7)
C14—C13—C18—C17	0.0	N2—N1—P2—P1	173.99 (19)
P2—C13—C18—C17	−176.72 (10)	C20—C19—P2—N1	77.91 (9)
C24—C19—C20—C21	0.0	C24—C19—P2—N1	−99.32 (9)
P2—C19—C20—C21	−177.21 (10)	C20—C19—P2—C13	−40.47 (9)
C19—C20—C21—C22	0.0	C24—C19—P2—C13	142.30 (8)
C20—C21—C22—C23	0.0	C20—C19—P2—Pd1	−177.10 (6)
C21—C22—C23—C24	0.0	C24—C19—P2—Pd1	5.67 (9)
C22—C23—C24—C19	0.0	C20—C19—P2—P1	117.93 (7)
C20—C19—C24—C23	0.0	C24—C19—P2—P1	−59.30 (9)
P2—C19—C24—C23	177.25 (10)	C14—C13—P2—N1	25.72 (10)
N2—N1—P1—C1	56.23 (17)	C18—C13—P2—N1	−157.53 (8)
P2—N1—P1—C1	−130.46 (7)	C14—C13—P2—C19	144.83 (8)
N2—N1—P1—C7	−58.99 (17)	C18—C13—P2—C19	−38.43 (9)
P2—N1—P1—C7	114.33 (7)	C14—C13—P2—Pd1	−78.21 (8)
N2—N1—P1—Pd1	−178.24 (16)	C18—C13—P2—Pd1	98.54 (8)
P2—N1—P1—Pd1	−4.92 (7)	C14—C13—P2—P1	−15.55 (10)
N2—N1—P1—P2	−173.3 (2)	C18—C13—P2—P1	161.20 (7)

Hydrogen-bond geometry (Å, º)

D—H···*A*	*D*—H	H···*A*	*D*···*A*	*D*—H···*A*
N2—H2*A*···Cl1^{i}	0.91 (2)	2.63 (2)	3.3066 (16)	132.0 (17)
N2—H2*B*···Cl2^{i}	0.82 (2)	2.58 (2)	3.3495 (17)	157 (2)

Symmetry code: (i) $x+1/2, -y+1/2, z+1/2$.