

**(Acetato- $\kappa^2O,O'$ )(acetato- $\kappa O$ )bis(2-amino-3-methylpyridine- $\kappa N^1$ )cobalt(II)**

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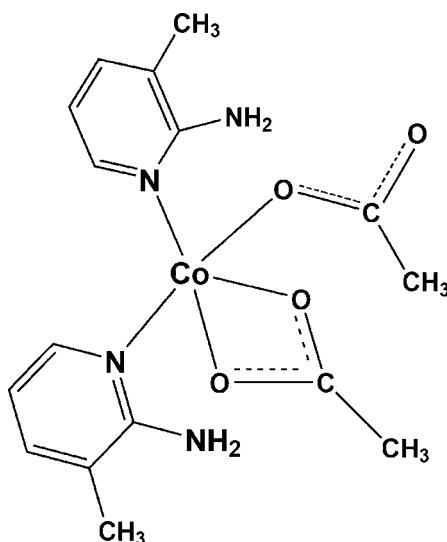
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Key indicators: single-crystal X-ray study;  $T = 298$  K; mean  $\sigma(C-C) = 0.005$  Å;  $R$  factor = 0.051;  $wR$  factor = 0.096; data-to-parameter ratio = 20.6.

In the title compound,  $[Co(CH_3COO)_2(C_6H_8N_2)_2]$ , the  $Co^{II}$  ion is five-coordinated by two pyridine N atoms from two 2-amino-3-methylpyridine ligands, two O atoms from one acetate ion and one O atom from another acetate ion in a distorted trigonal-bipyramidal geometry. The pyridine rings are nearly perpendicular to each other [dihedral angle = 84.49 (16)°]. The crystal packing is stabilized by intramolecular and intermolecular N–H···O hydrogen-bonding interactions.

## Related literature

For related coordination compounds of 2-amino-3-methylpyridine, see: Arab Ahmadi *et al.* (2011); Tadjarodi *et al.* (2010, 2012); Castillo *et al.* (2001); Ziegler *et al.* (2000); Amani Komaei *et al.* (1999); Chen *et al.* (2005). For proton-transfer compounds of 2-amino-3-methylpyridine, see: Carnevale *et al.* (2010).



## Experimental

### Crystal data

$[Co(CH_3COO)_2(C_6H_8N_2)_2]$	$\gamma = 72.42 (3)^\circ$
$M_r = 393.31$	$V = 930.1 (4) \text{ \AA}^3$
Triclinic, $P\bar{1}$	$Z = 2$
$a = 8.1685 (16) \text{ \AA}$	Mo $K\alpha$ radiation
$b = 10.452 (2) \text{ \AA}$	$\mu = 0.95 \text{ mm}^{-1}$
$c = 12.231 (2) \text{ \AA}$	$T = 298 \text{ K}$
$\alpha = 69.58 (3)^\circ$	$0.27 \times 0.23 \times 0.13 \text{ mm}$
$\beta = 79.94 (3)^\circ$	

### Data collection

Stoe IPDS 2T diffractometer	11215 measured reflections
Absorption correction: numerical ( <i>X-SHAPE</i> and <i>X-RED32</i> ; Stoe & Cie, 2005)	4996 independent reflections
	2756 reflections with $I > 2\sigma(I)$
	$R_{\text{int}} = 0.062$
	$T_{\min} = 0.785, T_{\max} = 0.886$

### Refinement

$R[F^2 > 2\sigma(F^2)] = 0.051$	H atoms treated by a mixture of independent and constrained refinement
$wR(F^2) = 0.096$	$\Delta\rho_{\max} = 0.35 \text{ e \AA}^{-3}$
$S = 0.92$	$\Delta\rho_{\min} = -0.19 \text{ e \AA}^{-3}$
4996 reflections	
242 parameters	
3 restraints	

**Table 1**  
Selected bond lengths (Å).

Co1–O1	1.962 (2)	Co1–N1	2.072 (2)
Co1–O3	2.352 (2)	Co1–N3	2.074 (2)
Co1–O4	2.0028 (18)		

**Table 2**  
Hydrogen-bond geometry (Å, °).

$D-H \cdots A$	$D-H$	$H \cdots A$	$D \cdots A$	$D-H \cdots A$
N2–H2A···O4	0.85 (2)	2.17 (2)	2.965 (3)	157 (3)
N2–H2B···O2 <sup>i</sup>	0.84 (2)	2.16 (2)	2.978 (3)	166 (3)
N4–H4A···O1	0.83 (3)	2.10 (3)	2.859 (3)	153 (3)
N4–H4B···O3 <sup>ii</sup>	0.84 (2)	2.06 (2)	2.881 (3)	164 (3)

Symmetry codes: (i)  $-x + 1, -y + 2, -z + 2$ ; (ii)  $-x + 2, -y + 2, -z + 1$ .

Data collection: *X-AREA* (Stoe & Cie, 2005); cell refinement: *X-AREA*; data reduction: *X-AREA*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *ORTEP-3 for Windows* (Farrugia, 1997); software used to prepare material for publication: *WinGX* (Farrugia, 1999).

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: XU5616).

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# supporting information

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## (Acetato- $\kappa^2 O,O'$ )(acetato- $\kappa O$ )bis(2-amino-3-methylpyridine- $\kappa N^1$ )cobalt(II)

**Azadeh Tadjarodi, Keyvan Bijanzad and Behrouz Notash**

### S1. Comment

2-Amino-3-methylpyridine (ampy) coordinates to metals mostly through the nitrogen atom of the pyridyl group (Arab Ahmadi *et al.*, 2011; Tadjarodi *et al.*, 2012 and 2010; Castillo *et al.*, 2001; Ziegler *et al.*, 2000; Amani Komaei *et al.*, 1999) but it can also coordinate *via* the nitrogen atom of the amino group (Chen *et al.*, 2005). In recent years, several structures of proton-transfer compounds, [(ampyH)<sub>2</sub>CoX<sub>4</sub>] ( $X = \text{Cl}, \text{Br}$ ) have been reported by 2-Amino-3-methylpyridine (Carnevale *et al.* 2010).

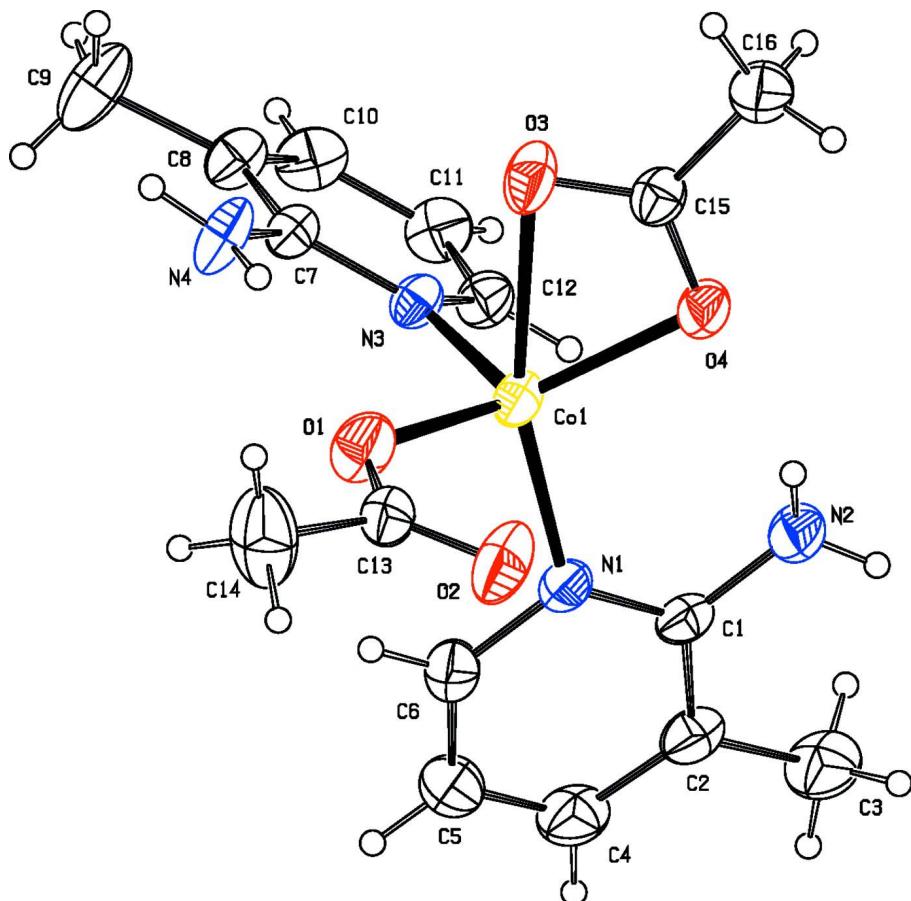
Herein, we report the synthesis and structural determination of the title compound, [Co(ampy)<sub>2</sub>(CH<sub>3</sub>COO)<sub>2</sub>]. The coordination sphere of the mononuclear complex includes three oxygen atoms from two acetate ions and two pyridyl nitrogen atoms from two ampy ligands thus constructing a distorted trigonal bipyramidal geometry (Fig. 1). In the structure of [Co(ampy)<sub>2</sub>(CH<sub>3</sub>COO)<sub>2</sub>], several intramolecular and intermolecular N—H···O hydrogen bond interactions formed between the amino group of the ligand and the acetate oxygen atoms which can stabilize the crystal structure (Fig. 2 & Table 1).

### S2. Experimental

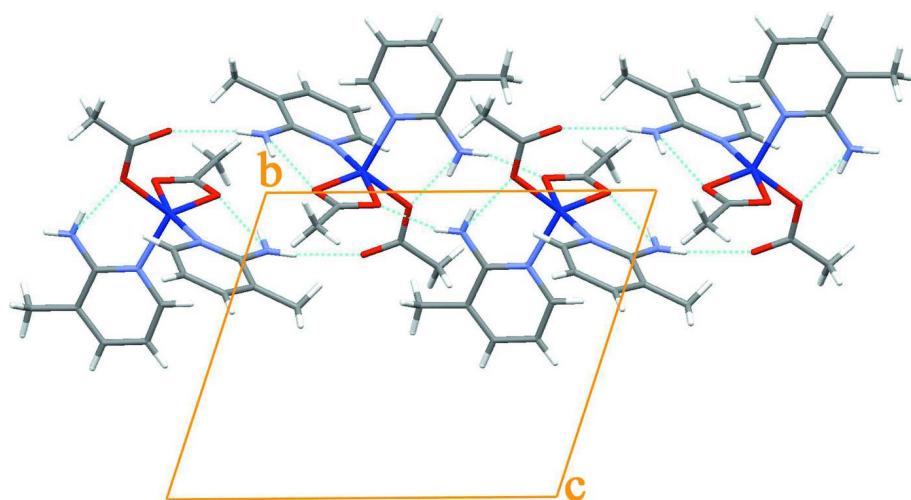
A solution of 2-amino-3-methylpyridine (1 mmol) in ethanol was added to an aqueous solution of Co(CH<sub>3</sub>COO)<sub>2</sub>·4H<sub>2</sub>O (0.5 mmol) and stirred for 20 min at 50 °C. Slow evaporation of the resulting solution gave violet plate shaped crystals of the title compound suitable for X-ray analysis (decomposition >300 °C).

### S3. Refinement

Hydrogen atoms attached to nitrogen atoms were found in difference Fourier map. H2A and H2B and H4B were refined with distance restraints of N—H 0.845 (18), 0.840 (18) and 0.839 (18), respectively. H atoms attached to carbon atoms were positioned geometrically and refined as riding atoms, with C—H = 0.93 Å (CH), with C—H = 0.96 Å (CH<sub>3</sub>), and  $U_{\text{iso}}(\text{H}) = 1.2, 1.5 U_{\text{eq}}(\text{C})$ .

**Figure 1**

The molecular structure of  $[\text{Co}(\text{ampy})_2(\text{CH}_3\text{COO})_2]$  with displacement ellipsoids drawn at 30% probability level.

**Figure 2**

The packing diagram of the title compound showing hydrogen bonding as blue dashed lines.

(Acetato- $\kappa^2O,O'$ )(acetato- $\kappa O$ )bis(2-amino-3-methylpyridine- $\kappa N^1$ )cobalt(II)

## Crystal data

[Co(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> (C <sub>6</sub> H <sub>8</sub> N <sub>2</sub> ) <sub>2</sub> ]	Z = 2
M <sub>r</sub> = 393.31	F(000) = 410
Triclinic, P1	D <sub>x</sub> = 1.404 Mg m <sup>-3</sup>
Hall symbol: -P 1	Mo K $\alpha$ radiation, $\lambda$ = 0.71073 Å
a = 8.1685 (16) Å	Cell parameters from 4996 reflections
b = 10.452 (2) Å	$\theta$ = 2.2–29.2°
c = 12.231 (2) Å	$\mu$ = 0.95 mm <sup>-1</sup>
$\alpha$ = 69.58 (3)°	T = 298 K
$\beta$ = 79.94 (3)°	Plate, violet
$\gamma$ = 72.42 (3)°	0.27 × 0.23 × 0.13 mm
V = 930.1 (4) Å <sup>3</sup>	

## Data collection

Stoe IPDS 2T	11215 measured reflections
diffractometer	4996 independent reflections
Radiation source: fine-focus sealed tube	2756 reflections with $I > 2\sigma(I)$
Graphite monochromator	$R_{\text{int}} = 0.062$
rotation method	$\theta_{\text{max}} = 29.2^\circ$ , $\theta_{\text{min}} = 2.2^\circ$
scans	$h = -11 \rightarrow 11$
Absorption correction: numerical	$k = -14 \rightarrow 14$
(X-SHAPE and X-RED32; Stoe & Cie, 2005)	$l = -16 \rightarrow 16$
$T_{\text{min}} = 0.785$ , $T_{\text{max}} = 0.886$	

## Refinement

Refinement on $F^2$	Secondary atom site location: difference Fourier map
Least-squares matrix: full	Hydrogen site location: inferred from neighbouring sites
$R[F^2 > 2\sigma(F^2)] = 0.051$	H atoms treated by a mixture of independent and constrained refinement
wR( $F^2$ ) = 0.096	$w = 1/[\sigma^2(F_o^2) + (0.0361P)^2]$ where $P = (F_o^2 + 2F_c^2)/3$
S = 0.92	$(\Delta/\sigma)_{\text{max}} = 0.001$
4996 reflections	$\Delta\rho_{\text{max}} = 0.35 \text{ e } \text{\AA}^{-3}$
242 parameters	$\Delta\rho_{\text{min}} = -0.19 \text{ e } \text{\AA}^{-3}$
3 restraints	
Primary atom site location: structure-invariant direct methods	

## Special details

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

**Refinement.** Refinement of  $F^2$  against ALL reflections. The weighted R-factor wR and goodness of fit S are based on  $F^2$ , conventional R-factors R are based on F, with F set to zero for negative  $F^2$ . The threshold expression of  $F^2 > \sigma(F^2)$  is used only for calculating R-factors(gt) etc. and is not relevant to the choice of reflections for refinement. R-factors based on  $F^2$  are statistically about twice as large as those based on F, and R-factors based on ALL data will be even larger.

Fractional atomic coordinates and isotropic or equivalent isotropic displacement parameters ( $\text{\AA}^2$ )

	x	y	z	$U_{\text{iso}}^*/U_{\text{eq}}$
Co1	0.71818 (5)	0.93397 (4)	0.77010 (3)	0.04555 (13)
O1	0.6158 (3)	1.0480 (2)	0.62129 (18)	0.0698 (6)
O2	0.4417 (3)	1.2043 (3)	0.6980 (2)	0.0879 (8)

O3	0.9471 (3)	1.0418 (2)	0.70296 (17)	0.0653 (6)
O4	0.8186 (2)	0.9932 (2)	0.87698 (16)	0.0593 (5)
N1	0.5289 (3)	0.8404 (3)	0.8723 (2)	0.0516 (6)
N2	0.6160 (3)	0.8098 (3)	1.0513 (2)	0.0569 (6)
N3	0.8801 (3)	0.7557 (2)	0.73364 (18)	0.0431 (5)
N4	0.9101 (4)	0.8685 (3)	0.5353 (2)	0.0638 (7)
C1	0.5153 (3)	0.7826 (3)	0.9897 (2)	0.0458 (6)
C2	0.4051 (4)	0.6933 (3)	1.0468 (3)	0.0570 (8)
C3	0.3999 (5)	0.6244 (4)	1.1759 (3)	0.0808 (11)
H3A	0.3216	0.5655	1.1991	0.121*
H3B	0.3618	0.6957	1.2141	0.121*
H3C	0.5130	0.5676	1.1978	0.121*
C4	0.3094 (4)	0.6719 (4)	0.9766 (3)	0.0737 (10)
H4	0.2364	0.6131	1.0110	0.088*
C5	0.3170 (4)	0.7344 (4)	0.8568 (3)	0.0813 (11)
H5	0.2486	0.7206	0.8108	0.098*
C6	0.4280 (4)	0.8170 (4)	0.8083 (3)	0.0684 (9)
H6	0.4350	0.8593	0.7276	0.082*
C7	0.9548 (3)	0.7526 (3)	0.6262 (2)	0.0435 (6)
C8	1.0746 (4)	0.6286 (3)	0.6109 (3)	0.0540 (7)
C9	1.1499 (5)	0.6286 (4)	0.4888 (3)	0.0899 (12)
H9A	1.2360	0.5413	0.4930	0.135*
H9B	1.2013	0.7063	0.4530	0.135*
H9C	1.0602	0.6381	0.4430	0.135*
C10	1.1139 (4)	0.5139 (3)	0.7075 (3)	0.0636 (8)
H10	1.1933	0.4319	0.6997	0.076*
C11	1.0377 (4)	0.5169 (3)	0.8177 (3)	0.0607 (8)
H11	1.0649	0.4385	0.8837	0.073*
C12	0.9222 (4)	0.6381 (3)	0.8255 (2)	0.0521 (7)
H12	0.8689	0.6400	0.8988	0.063*
C13	0.5012 (4)	1.1626 (3)	0.6146 (3)	0.0553 (7)
C14	0.4425 (6)	1.2476 (5)	0.4946 (4)	0.1086 (15)
H14A	0.3280	1.3066	0.5011	0.163*
H14B	0.4430	1.1849	0.4528	0.163*
H14C	0.5191	1.3057	0.4530	0.163*
C15	0.9323 (4)	1.0452 (3)	0.8040 (2)	0.0492 (7)
C16	1.0438 (4)	1.1079 (4)	0.8434 (3)	0.0724 (10)
H16A	1.1267	1.0337	0.8925	0.109*
H16B	0.9738	1.1690	0.8865	0.109*
H16C	1.1027	1.1615	0.7763	0.109*
H2A	0.666 (4)	0.874 (3)	1.016 (3)	0.087*
H4A	0.842 (4)	0.941 (4)	0.545 (3)	0.087*
H2B	0.587 (4)	0.798 (4)	1.1228 (17)	0.087*
H4B	0.960 (4)	0.877 (4)	0.4681 (19)	0.087*

Atomic displacement parameters ( $\text{\AA}^2$ )

	$U^{11}$	$U^{22}$	$U^{33}$	$U^{12}$	$U^{13}$	$U^{23}$
Co1	0.0517 (2)	0.0480 (2)	0.0384 (2)	-0.01574 (17)	0.00583 (15)	-0.01758 (17)
O1	0.0657 (14)	0.0686 (15)	0.0551 (14)	0.0066 (12)	-0.0049 (10)	-0.0157 (12)
O2	0.1122 (19)	0.0934 (19)	0.0651 (16)	-0.0283 (15)	0.0210 (13)	-0.0454 (15)
O3	0.0945 (15)	0.0705 (15)	0.0374 (12)	-0.0391 (12)	0.0109 (10)	-0.0177 (10)
O4	0.0669 (13)	0.0814 (15)	0.0415 (11)	-0.0407 (11)	0.0106 (9)	-0.0227 (11)
N1	0.0485 (13)	0.0653 (16)	0.0505 (15)	-0.0228 (12)	0.0103 (10)	-0.0300 (13)
N2	0.0629 (16)	0.0674 (18)	0.0432 (15)	-0.0304 (13)	0.0048 (12)	-0.0134 (14)
N3	0.0491 (13)	0.0397 (13)	0.0371 (13)	-0.0156 (10)	0.0050 (10)	-0.0088 (11)
N4	0.090 (2)	0.0453 (16)	0.0374 (15)	-0.0059 (14)	0.0174 (13)	-0.0117 (13)
C1	0.0416 (14)	0.0437 (16)	0.0521 (17)	-0.0121 (12)	0.0104 (12)	-0.0209 (14)
C2	0.0567 (17)	0.0534 (19)	0.062 (2)	-0.0219 (14)	0.0157 (15)	-0.0234 (16)
C3	0.088 (3)	0.077 (3)	0.076 (3)	-0.046 (2)	0.013 (2)	-0.012 (2)
C4	0.073 (2)	0.076 (2)	0.089 (3)	-0.0447 (19)	0.0195 (19)	-0.037 (2)
C5	0.078 (2)	0.112 (3)	0.086 (3)	-0.056 (2)	0.0105 (19)	-0.052 (3)
C6	0.070 (2)	0.096 (3)	0.058 (2)	-0.0366 (19)	0.0070 (16)	-0.039 (2)
C7	0.0474 (15)	0.0409 (16)	0.0431 (16)	-0.0148 (12)	0.0059 (12)	-0.0161 (14)
C8	0.0600 (18)	0.0420 (17)	0.0564 (19)	-0.0130 (14)	0.0082 (14)	-0.0174 (15)
C9	0.116 (3)	0.061 (2)	0.072 (2)	-0.004 (2)	0.030 (2)	-0.030 (2)
C10	0.0599 (19)	0.0438 (18)	0.079 (2)	-0.0070 (15)	0.0005 (17)	-0.0184 (18)
C11	0.0646 (19)	0.0485 (19)	0.057 (2)	-0.0119 (15)	-0.0061 (15)	-0.0034 (15)
C12	0.0559 (17)	0.0555 (19)	0.0431 (17)	-0.0218 (15)	0.0030 (13)	-0.0103 (15)
C13	0.0556 (18)	0.062 (2)	0.0513 (18)	-0.0127 (16)	-0.0026 (14)	-0.0246 (16)
C14	0.135 (4)	0.091 (3)	0.082 (3)	0.021 (3)	-0.048 (3)	-0.030 (2)
C15	0.0570 (17)	0.0450 (17)	0.0443 (17)	-0.0170 (14)	0.0021 (13)	-0.0124 (13)
C16	0.073 (2)	0.093 (3)	0.068 (2)	-0.045 (2)	0.0090 (17)	-0.032 (2)

Geometric parameters ( $\text{\AA}$ ,  $^\circ$ )

Co1—O1	1.962 (2)	C4—C5	1.380 (5)
Co1—O3	2.352 (2)	C4—H4	0.9300
Co1—O4	2.0028 (18)	C5—C6	1.359 (4)
Co1—N1	2.072 (2)	C5—H5	0.9300
Co1—N3	2.074 (2)	C6—H6	0.9300
O1—C13	1.265 (4)	C7—C8	1.419 (4)
O2—C13	1.215 (3)	C8—C10	1.360 (4)
O3—C15	1.233 (3)	C8—C9	1.512 (4)
O4—C15	1.277 (3)	C9—H9A	0.9600
N1—C1	1.349 (3)	C9—H9B	0.9600
N1—C6	1.353 (3)	C9—H9C	0.9600
N2—C1	1.354 (4)	C10—C11	1.389 (4)
N2—H2A	0.845 (18)	C10—H10	0.9300
N2—H2B	0.840 (18)	C11—C12	1.354 (4)
N3—C12	1.345 (4)	C11—H11	0.9300
N3—C7	1.355 (3)	C12—H12	0.9300
N4—C7	1.331 (4)	C13—C14	1.501 (5)

N4—H4A	0.83 (3)	C14—H14A	0.9600
N4—H4B	0.839 (18)	C14—H14B	0.9600
C1—C2	1.414 (4)	C14—H14C	0.9600
C2—C4	1.367 (4)	C15—C16	1.492 (4)
C2—C3	1.489 (4)	C16—H16A	0.9600
C3—H3A	0.9600	C16—H16B	0.9600
C3—H3B	0.9600	C16—H16C	0.9600
C3—H3C	0.9600		
O1—Co1—O4	129.30 (10)	N1—C6—C5	122.9 (3)
O1—Co1—N1	104.36 (10)	N1—C6—H6	118.5
O4—Co1—N1	105.67 (8)	C5—C6—H6	118.5
O1—Co1—N3	103.15 (9)	N4—C7—N3	118.0 (2)
O4—Co1—N3	112.27 (9)	N4—C7—C8	121.0 (2)
N1—Co1—N3	97.38 (9)	N3—C7—C8	121.0 (3)
O1—Co1—O3	88.36 (9)	C10—C8—C7	117.8 (3)
O4—Co1—O3	58.90 (7)	C10—C8—C9	123.1 (3)
N1—Co1—O3	164.49 (7)	C7—C8—C9	119.1 (3)
N3—Co1—O3	88.12 (8)	C8—C9—H9A	109.5
C13—O1—Co1	119.87 (19)	C8—C9—H9B	109.5
C15—O3—Co1	83.56 (16)	H9A—C9—H9B	109.5
C15—O4—Co1	98.54 (16)	C8—C9—H9C	109.5
C1—N1—C6	118.6 (2)	H9A—C9—H9C	109.5
C1—N1—Co1	127.67 (17)	H9B—C9—H9C	109.5
C6—N1—Co1	112.7 (2)	C8—C10—C11	121.3 (3)
C1—N2—H2A	118 (2)	C8—C10—H10	119.4
C1—N2—H2B	118 (2)	C11—C10—H10	119.4
H2A—N2—H2B	116 (3)	C12—C11—C10	117.7 (3)
C12—N3—C7	118.3 (2)	C12—C11—H11	121.2
C12—N3—Co1	116.71 (17)	C10—C11—H11	121.2
C7—N3—Co1	124.82 (18)	N3—C12—C11	123.9 (3)
C7—N4—H4A	120 (3)	N3—C12—H12	118.0
C7—N4—H4B	123 (3)	C11—C12—H12	118.0
H4A—N4—H4B	116 (4)	O2—C13—O1	123.5 (3)
N1—C1—N2	117.2 (2)	O2—C13—C14	121.0 (3)
N1—C1—C2	121.9 (2)	O1—C13—C14	115.5 (3)
N2—C1—C2	120.9 (3)	C13—C14—H14A	109.5
C4—C2—C1	116.4 (3)	C13—C14—H14B	109.5
C4—C2—C3	122.9 (3)	H14A—C14—H14B	109.5
C1—C2—C3	120.8 (3)	C13—C14—H14C	109.5
C2—C3—H3A	109.5	H14A—C14—H14C	109.5
C2—C3—H3B	109.5	H14B—C14—H14C	109.5
H3A—C3—H3B	109.5	O3—C15—O4	119.0 (2)
C2—C3—H3C	109.5	O3—C15—C16	121.8 (3)
H3A—C3—H3C	109.5	O4—C15—C16	119.2 (2)
H3B—C3—H3C	109.5	C15—C16—H16A	109.5
C2—C4—C5	122.5 (3)	C15—C16—H16B	109.5
C2—C4—H4	118.7	H16A—C16—H16B	109.5

C5—C4—H4	118.7	C15—C16—H16C	109.5
C6—C5—C4	117.6 (3)	H16A—C16—H16C	109.5
C6—C5—H5	121.2	H16B—C16—H16C	109.5
C4—C5—H5	121.2		
O4—Co1—O1—C13	−50.1 (3)	Co1—N1—C1—C2	−164.79 (19)
N1—Co1—O1—C13	74.6 (2)	N1—C1—C2—C4	−1.8 (4)
N3—Co1—O1—C13	175.9 (2)	N2—C1—C2—C4	−179.6 (3)
O3—Co1—O1—C13	−96.4 (2)	N1—C1—C2—C3	176.5 (3)
O1—Co1—O3—C15	138.61 (18)	N2—C1—C2—C3	−1.3 (4)
O4—Co1—O3—C15	−0.62 (17)	C1—C2—C4—C5	−0.6 (5)
N1—Co1—O3—C15	−6.9 (4)	C3—C2—C4—C5	−179.0 (3)
N3—Co1—O3—C15	−118.18 (18)	C2—C4—C5—C6	1.7 (6)
O1—Co1—O4—C15	−56.9 (2)	C1—N1—C6—C5	−1.9 (5)
N1—Co1—O4—C15	178.84 (17)	Co1—N1—C6—C5	167.7 (3)
N3—Co1—O4—C15	73.83 (19)	C4—C5—C6—N1	−0.4 (5)
O3—Co1—O4—C15	0.60 (16)	C12—N3—C7—N4	178.7 (2)
O1—Co1—N1—C1	−161.2 (2)	Co1—N3—C7—N4	−6.2 (3)
O4—Co1—N1—C1	−22.5 (2)	C12—N3—C7—C8	−0.1 (4)
N3—Co1—N1—C1	93.1 (2)	Co1—N3—C7—C8	174.98 (19)
O3—Co1—N1—C1	−16.9 (5)	N4—C7—C8—C10	−179.8 (3)
O1—Co1—N1—C6	30.3 (2)	N3—C7—C8—C10	−1.0 (4)
O4—Co1—N1—C6	169.0 (2)	N4—C7—C8—C9	−0.9 (4)
N3—Co1—N1—C6	−75.3 (2)	N3—C7—C8—C9	177.9 (3)
O3—Co1—N1—C6	174.6 (3)	C7—C8—C10—C11	0.9 (4)
O1—Co1—N3—C12	−157.47 (18)	C9—C8—C10—C11	−177.9 (3)
O4—Co1—N3—C12	59.53 (19)	C8—C10—C11—C12	0.2 (4)
N1—Co1—N3—C12	−50.79 (19)	C7—N3—C12—C11	1.3 (4)
O3—Co1—N3—C12	114.65 (18)	Co1—N3—C12—C11	−174.1 (2)
O1—Co1—N3—C7	27.4 (2)	C10—C11—C12—N3	−1.4 (4)
O4—Co1—N3—C7	−115.6 (2)	Co1—O1—C13—O2	−4.2 (4)
N1—Co1—N3—C7	134.1 (2)	Co1—O1—C13—C14	175.0 (3)
O3—Co1—N3—C7	−60.5 (2)	Co1—O3—C15—O4	0.9 (3)
C6—N1—C1—N2	−179.0 (3)	Co1—O3—C15—C16	−179.2 (3)
Co1—N1—C1—N2	13.1 (4)	Co1—O4—C15—O3	−1.1 (3)
C6—N1—C1—C2	3.1 (4)	Co1—O4—C15—C16	179.0 (2)

*Hydrogen-bond geometry (Å, °)*

D—H···A	D—H	H···A	D···A	D—H···A
N2—H2A···O4	0.85 (2)	2.17 (2)	2.965 (3)	157 (3)
N2—H2B···O2 <sup>i</sup>	0.84 (2)	2.16 (2)	2.978 (3)	166 (3)
N4—H4A···O1	0.83 (3)	2.10 (3)	2.859 (3)	153 (3)
N4—H4B···O3 <sup>ii</sup>	0.84 (2)	2.06 (2)	2.881 (3)	164 (3)

Symmetry codes: (i)  $-x+1, -y+2, -z+2$ ; (ii)  $-x+2, -y+2, -z+1$ .