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Bis(2-hydroxyiminomethyl-6-methoxyphenolato- $\kappa^2O^1, N$ )cobalt(II)

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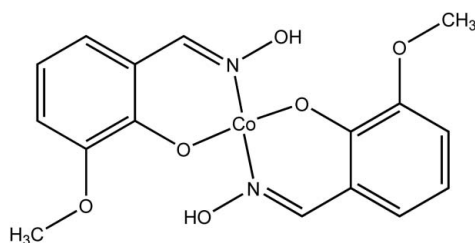
Received 10 November 2008; accepted 24 November 2008

Key indicators: single-crystal X-ray study;  $T = 293$  K; mean  $\sigma(C-C) = 0.003$  Å;  
R factor = 0.025;  $wR$  factor = 0.065; data-to-parameter ratio = 12.2.

In the title compound,  $[Co(C_8H_8NO_3)_2]$ , the  $Co^{II}$  atom lies on a centre of inversion and is coordinated in a slightly distorted square-planar geometry by two N and two O atoms from the 2-hydroxyiminomethyl-6-methoxyphenolate ligands. Intramolecular  $O-H \cdots O$  hydrogen bonds are formed and the complexes form stacks along the  $b$  axis, with an interplanar separation of 3.332 (1) Å between complexes. Pairs of  $C-H \cdots O$  contacts are formed between complexes in neighbouring stacks.

## Related literature

For recent related literature concerning Schiff-base compounds, see: Gupta & Sutar (2008); Sreenivasulu *et al.* (2005); Zhang *et al.* (2008); Raptopoulou *et al.* (2006); Milios *et al.* (2006); Yang *et al.* (2007).



## Experimental

## Crystal data

 $[Co(C_8H_8NO_3)_2]$  $M_r = 391.24$ 

Monoclinic,  $P2_1/n$   
 $a = 8.4254$  (19) Å  
 $b = 4.9111$  (11) Å  
 $c = 18.951$  (4) Å  
 $\beta = 95.375$  (3)°  
 $V = 780.7$  (3) Å<sup>3</sup>

$Z = 2$   
Mo  $K\alpha$  radiation  
 $\mu = 1.14$  mm<sup>-1</sup>  
 $T = 293$  (2) K  
 $0.22 \times 0.18 \times 0.14$  mm

## Data collection

Bruker SMART CCD  
diffractometer  
Absorption correction: none  
4577 measured reflections

1433 independent reflections  
1216 reflections with  $I > 2\sigma(I)$   
 $R_{int} = 0.021$

## Refinement

$R[F^2 > 2\sigma(F^2)] = 0.025$   
 $wR(F^2) = 0.065$   
 $S = 1.04$   
1433 reflections

117 parameters  
H-atom parameters constrained  
 $\Delta\rho_{max} = 0.23$  e Å<sup>-3</sup>  
 $\Delta\rho_{min} = -0.17$  e Å<sup>-3</sup>

Table 1

Hydrogen-bond geometry (Å, °).

$D-H \cdots A$	$D-H$	$H \cdots A$	$D \cdots A$	$D-H \cdots A$
$O2-H2 \cdots O1^i$	0.82	1.91	2.5336 (19)	132
$C7-H7 \cdots O2^{ii}$	0.93	2.48	3.321 (2)	150

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

Data collection: *SMART* (Bruker, 2000); cell refinement: *SAINT* (Bruker, 2000); data reduction: *SAINT*; program(s) used to solve structure: *SHELXS97* (Sheldrick, 2008); program(s) used to refine structure: *SHELXL97* (Sheldrick, 2008); molecular graphics: *SHELXTL* (Sheldrick, 2008); software used to prepare material for publication: *SHELXTL*.

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Supplementary data and figures for this paper are available from the IUCr electronic archives (Reference: B12324).

## References

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**supplementary materials**

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## Bis(2-hydroxyiminomethyl-6-methoxyphenolato- $\kappa^2O^1,N$ )cobalt(II)

S. H. Zhang, C. M. Ge and C. Feng

### Comment

Schiff-base complexes have been studied for many years (Gupta & Sutar, 2008; Sreenivasulu *et al.*, 2005; Zhang *et al.*, 2008) and have aroused increasing interest because of their antiviral, anticancer, catalytic and fluorescent properties. Most model studies of metal complexes of Schiff-base ligands containing salicylaldehyde derivatives and oxime have focused on the binding mode of the ligands (Raptopoulou *et al.*, 2006; Milios *et al.*, 2006; Yang *et al.*, 2007). The crystal structures of the complexes demonstrate that the Schiff-base ligands act in a bidentate, tridentate or  $\mu^5\text{:}\eta^1\text{:}\eta^2\text{:}\eta^3$  mode, coordinating through the phenolato O, imine N, or oxime O atoms. Our research group is interested in the Schiff-base derived from 2-hydroxy-3-methoxy-benzaldehyde and hydroxylammonium chloride.

### Experimental

A solution of (0.152 g, 1.0 mmol) 2-hydroxy-3-methoxy-benzaldehyde oxime and (0.056 g, 1 mmol) potassium hydroxide in 20 ml absolute methanol was added slowly to a solution of  $\text{CoNO}_3 \cdot 6\text{H}_2\text{O}$  (0.145 g, 0.5 mmol) in methanol. The mixture was stirred for 1 h at room temperature to give a red solution which was filtered and the filtrate was left to stand at room temperature. Red block crystals suitable for were obtained by slow evaporation Yield: 80.1 % (based on Co). Elemental analysis calculated: C 49.12, H 4.12, N 7.16 %; found: C 48.99, H 4.21, N 7.22 %.

### Refinement

H atoms were positioned geometrically and refined with a riding model, with distances 0.96 (CH<sub>3</sub>) or 0.93 Å (aromatic ring), and with  $U_{\text{iso}}(\text{H}) = 1.2 U_{\text{eq}}(\text{aromatic ring})$  or  $U_{\text{iso}}(\text{H}) = 1.5 U_{\text{eq}}(\text{CH}_3)$ , and with O–H distance 0.82 Å and  $U_{\text{iso}}(\text{H}) = 1.5 U_{\text{eq}}(\text{O})$ .

### Figures

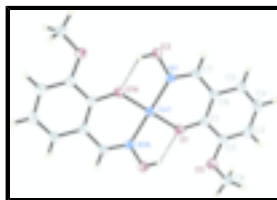


Fig. 1. Molecular structure of the title compound, showing 30% probability displacement ellipsoids for non-H atoms. Dashed lines denote O—H...O hydrogen bonds. Symmetry code (A):  $-x, 1 - y, -z$ .

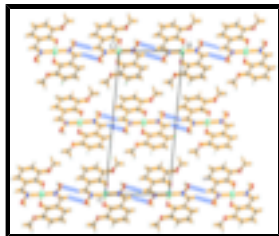


Fig. 2. Packing diagram viewed down the *b* axis. Dashed lines denote C—H...O contacts.

## Bis(2-hydroxyiminomethyl-6-methoxyphenolato- $\kappa^2O^1, N$ )cobalt(II)

### Crystal data

[Co(C<sub>8</sub>H<sub>8</sub>NO<sub>3</sub>)<sub>2</sub>]

*M<sub>r</sub>* = 391.24

Monoclinic, *P*2<sub>1</sub>/*n*

Hall symbol: -*P* 2<sub>1</sub>/*n*

*a* = 8.4254 (19) Å

*b* = 4.9111 (11) Å

*c* = 18.951 (4) Å

β = 95.375 (3)°

*V* = 780.7 (3) Å<sup>3</sup>

*Z* = 2

*F*<sub>000</sub> = 402

*D<sub>x</sub>* = 1.664 Mg m<sup>-3</sup>

Mo *K*α radiation

λ = 0.71073 Å

Cell parameters from 4577 reflections

θ = 2.6–25.5°

μ = 1.14 mm<sup>-1</sup>

*T* = 293 (2) K

Block, red

0.22 × 0.18 × 0.14 mm

### Data collection

Bruker SMART CCD  
diffractometer

Radiation source: fine-focus sealed tube

Monochromator: graphite

*T* = 293(2) K

φ and ω scans

Absorption correction: none

4577 measured reflections

1433 independent reflections

1216 reflections with *I* > 2σ(*I*)

*R*<sub>int</sub> = 0.021

θ<sub>max</sub> = 25.5°

θ<sub>min</sub> = 2.6°

*h* = -10→10

*k* = -5→5

*l* = -22→22

### Refinement

Refinement on *F*<sup>2</sup>

Least-squares matrix: full

*R* [*F*<sup>2</sup> > 2σ(*F*<sup>2</sup>)] = 0.025

*wR*(*F*<sup>2</sup>) = 0.065

*S* = 1.04

1433 reflections

117 parameters

Secondary atom site location: difference Fourier map

Hydrogen site location: inferred from neighbouring sites

H-atom parameters constrained

$$w = 1/[\sigma^2(F_o^2) + (0.0303P)^2 + 0.2885P]$$

where *P* = (*F<sub>o</sub>*<sup>2</sup> + 2*F<sub>c</sub>*<sup>2</sup>)/3

(Δσ)<sub>max</sub> < 0.001

Δρ<sub>max</sub> = 0.23 e Å<sup>-3</sup>

Δρ<sub>min</sub> = -0.17 e Å<sup>-3</sup>

Primary atom site location: structure-invariant direct methods Extinction correction: none

*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.

**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  $F^2 > 2\text{sigma}(F^2)$  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	0.0000	0.5000	0.0000	0.03262 (15)
C1	0.1093 (2)	0.0793 (4)	0.09770 (10)	0.0353 (4)
C2	0.0701 (2)	-0.1107 (4)	0.14960 (10)	0.0377 (5)
C3	0.1851 (3)	-0.2781 (4)	0.18262 (11)	0.0448 (5)
H3	0.1581	-0.4028	0.2164	0.054*
C4	0.3423 (3)	-0.2610 (4)	0.16538 (11)	0.0477 (6)
H4	0.4196	-0.3744	0.1880	0.057*
C5	0.3837 (3)	-0.0794 (4)	0.11564 (11)	0.0429 (5)
H5	0.4889	-0.0696	0.1048	0.052*
C6	0.2676 (2)	0.0939 (4)	0.08055 (10)	0.0361 (4)
C7	0.3153 (2)	0.2796 (4)	0.02809 (10)	0.0386 (5)
H7	0.4217	0.2799	0.0187	0.046*
C8	-0.1391 (3)	-0.3153 (5)	0.20761 (12)	0.0535 (6)
H8A	-0.1090	-0.4897	0.1902	0.080*
H8B	-0.2529	-0.3074	0.2077	0.080*
H8C	-0.0903	-0.2898	0.2550	0.080*
N1	0.21926 (19)	0.4465 (3)	-0.00691 (8)	0.0363 (4)
O1	-0.00708 (15)	0.2354 (3)	0.06754 (7)	0.0387 (3)
O2	0.29495 (16)	0.6086 (3)	-0.05443 (8)	0.0487 (4)
H2	0.2301	0.7143	-0.0744	0.073*
O3	-0.08737 (17)	-0.1063 (3)	0.16291 (8)	0.0494 (4)

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

	$U^{11}$	$U^{22}$	$U^{33}$	$U^{12}$	$U^{13}$	$U^{23}$
Co1	0.0291 (2)	0.0337 (2)	0.0348 (2)	-0.00160 (15)	0.00146 (15)	0.00203 (16)
C1	0.0385 (11)	0.0311 (10)	0.0354 (11)	0.0001 (8)	-0.0005 (9)	-0.0038 (8)
C2	0.0415 (11)	0.0352 (10)	0.0362 (11)	-0.0016 (9)	0.0025 (9)	-0.0015 (9)
C3	0.0566 (14)	0.0375 (11)	0.0392 (11)	-0.0009 (10)	-0.0007 (10)	0.0040 (9)
C4	0.0503 (13)	0.0425 (12)	0.0478 (13)	0.0103 (10)	-0.0080 (10)	-0.0001 (10)
C5	0.0384 (11)	0.0455 (12)	0.0436 (12)	0.0057 (9)	-0.0030 (9)	-0.0045 (10)

## supplementary materials

C6	0.0360 (10)	0.0350 (10)	0.0364 (11)	-0.0010 (8)	-0.0017 (8)	-0.0043 (8)
C7	0.0286 (10)	0.0438 (11)	0.0429 (11)	0.0001 (9)	0.0016 (8)	-0.0041 (9)
C8	0.0591 (14)	0.0510 (14)	0.0524 (13)	-0.0079 (11)	0.0160 (11)	0.0078 (11)
N1	0.0327 (9)	0.0410 (10)	0.0352 (9)	-0.0053 (7)	0.0040 (7)	0.0019 (7)
O1	0.0332 (7)	0.0397 (8)	0.0434 (8)	0.0005 (6)	0.0044 (6)	0.0083 (6)
O2	0.0346 (8)	0.0598 (10)	0.0523 (9)	-0.0032 (7)	0.0070 (7)	0.0185 (8)
O3	0.0452 (9)	0.0493 (8)	0.0547 (9)	-0.0010 (7)	0.0105 (7)	0.0153 (8)

### Geometric parameters (Å, °)

Co1—O1	1.8290 (13)	C4—H4	0.930
Co1—O1 <sup>i</sup>	1.8290 (13)	C5—C6	1.414 (3)
Co1—N1	1.8826 (17)	C5—H5	0.930
Co1—N1 <sup>i</sup>	1.8826 (17)	C6—C7	1.434 (3)
C1—O1	1.331 (2)	C7—N1	1.290 (2)
C1—C6	1.404 (3)	C7—H7	0.930
C1—C2	1.417 (3)	C8—O3	1.425 (2)
C2—O3	1.374 (2)	C8—H8A	0.960
C2—C3	1.376 (3)	C8—H8B	0.960
C3—C4	1.396 (3)	C8—H8C	0.960
C3—H3	0.930	N1—O2	1.400 (2)
C4—C5	1.367 (3)	O2—H2	0.820
O1—Co1—O1 <sup>i</sup>	180.00 (8)	C6—C5—H5	119.8
O1—Co1—N1	92.64 (6)	C1—C6—C5	119.37 (19)
O1 <sup>i</sup> —Co1—N1	87.36 (6)	C1—C6—C7	121.78 (18)
O1—Co1—N1 <sup>i</sup>	87.36 (6)	C5—C6—C7	118.86 (18)
O1 <sup>i</sup> —Co1—N1 <sup>i</sup>	92.64 (6)	N1—C7—C6	123.89 (18)
N1—Co1—N1 <sup>i</sup>	180.00 (13)	N1—C7—H7	118.1
O1—C1—C6	123.29 (18)	C6—C7—H7	118.1
O1—C1—C2	117.87 (18)	O3—C8—H8A	109.5
C6—C1—C2	118.84 (17)	O3—C8—H8B	109.5
O3—C2—C3	125.24 (19)	H8A—C8—H8B	109.5
O3—C2—C1	114.13 (17)	O3—C8—H8C	109.5
C3—C2—C1	120.62 (19)	H8A—C8—H8C	109.5
C2—C3—C4	120.0 (2)	H8B—C8—H8C	109.5
C2—C3—H3	120.0	C7—N1—O2	112.97 (16)
C4—C3—H3	120.0	C7—N1—Co1	128.68 (14)
C5—C4—C3	120.65 (19)	O2—N1—Co1	118.33 (12)
C5—C4—H4	119.7	C1—O1—Co1	129.71 (13)
C3—C4—H4	119.7	N1—O2—H2	109.5
C4—C5—C6	120.5 (2)	C2—O3—C8	116.90 (17)
C4—C5—H5	119.8		

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

### Hydrogen-bond geometry (Å, °)

D—H $\cdots$ A	D—H	H $\cdots$ A	D $\cdots$ A	D—H $\cdots$ A
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O2—H2···O1 <sup>i</sup>	0.82	1.91	2.5336 (19)	132
C7—H7···O2 <sup>ii</sup>	0.93	2.48	3.321 (2)	150

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

Fig. 1

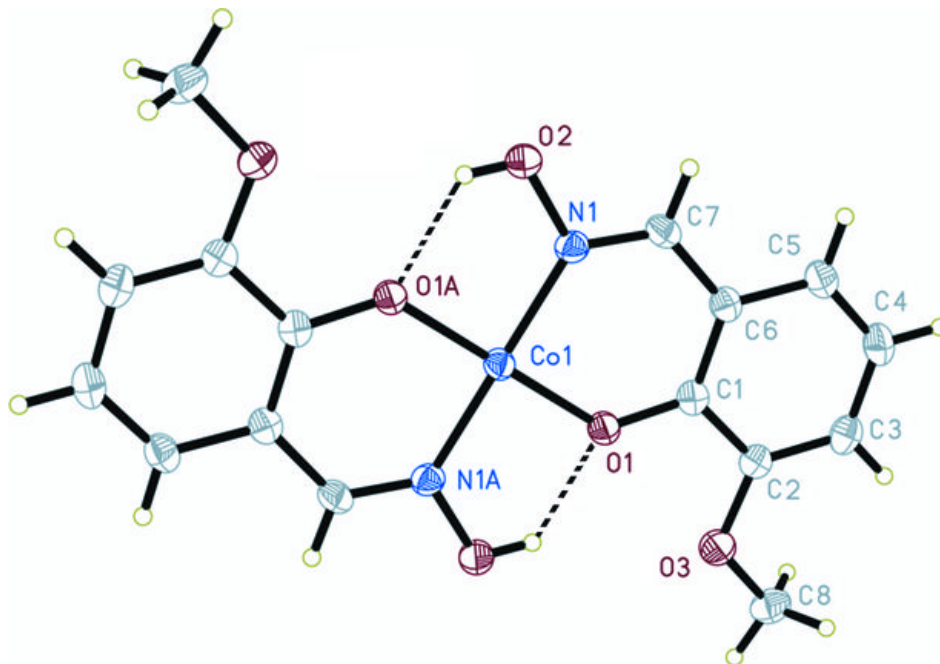




Fig. 2

